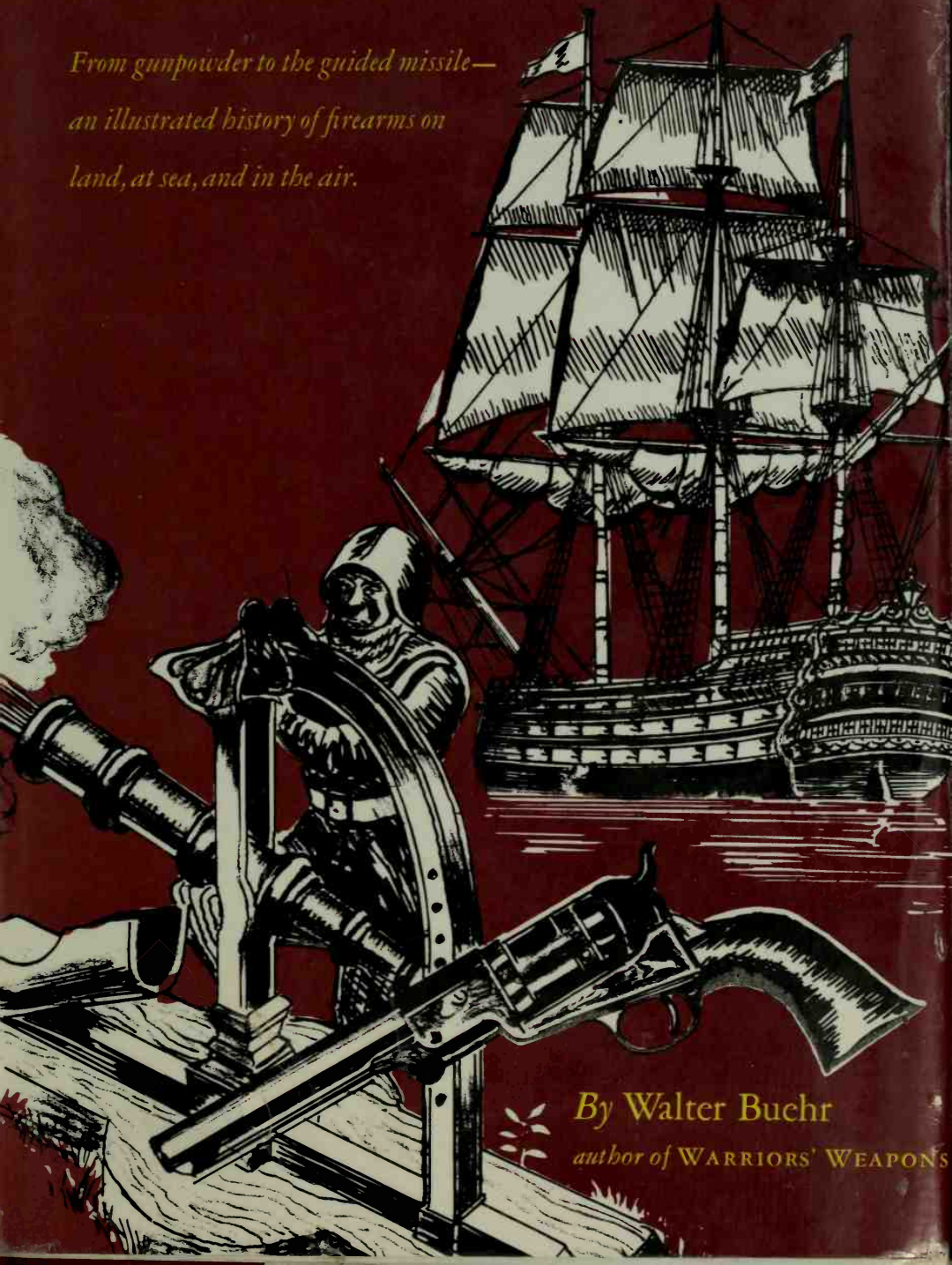
FIREARMS

From gunpowder to the guided missile—an illustrated history of firearms on land, at sea, and in the air.



By Walter Buehr

author of WARRIORS' WEAPONS

$5.95

FIREARMS

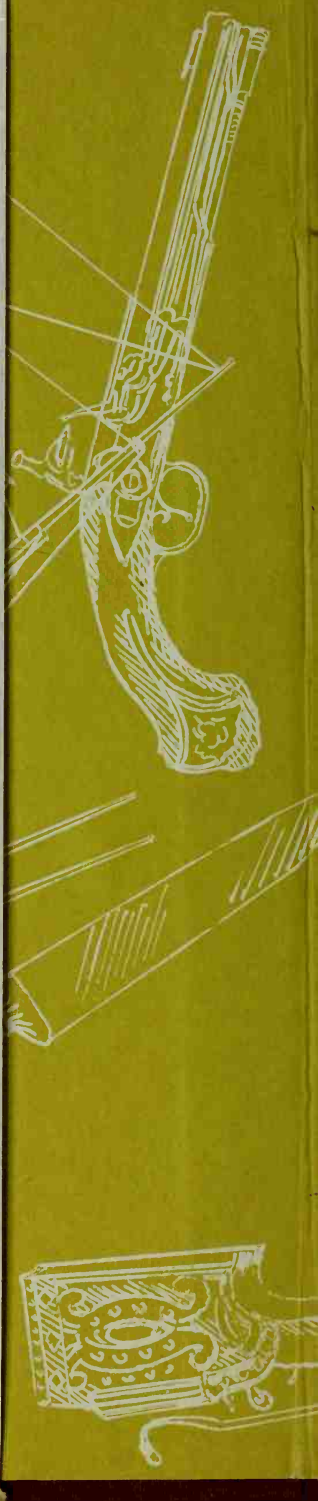
Walter Buehr

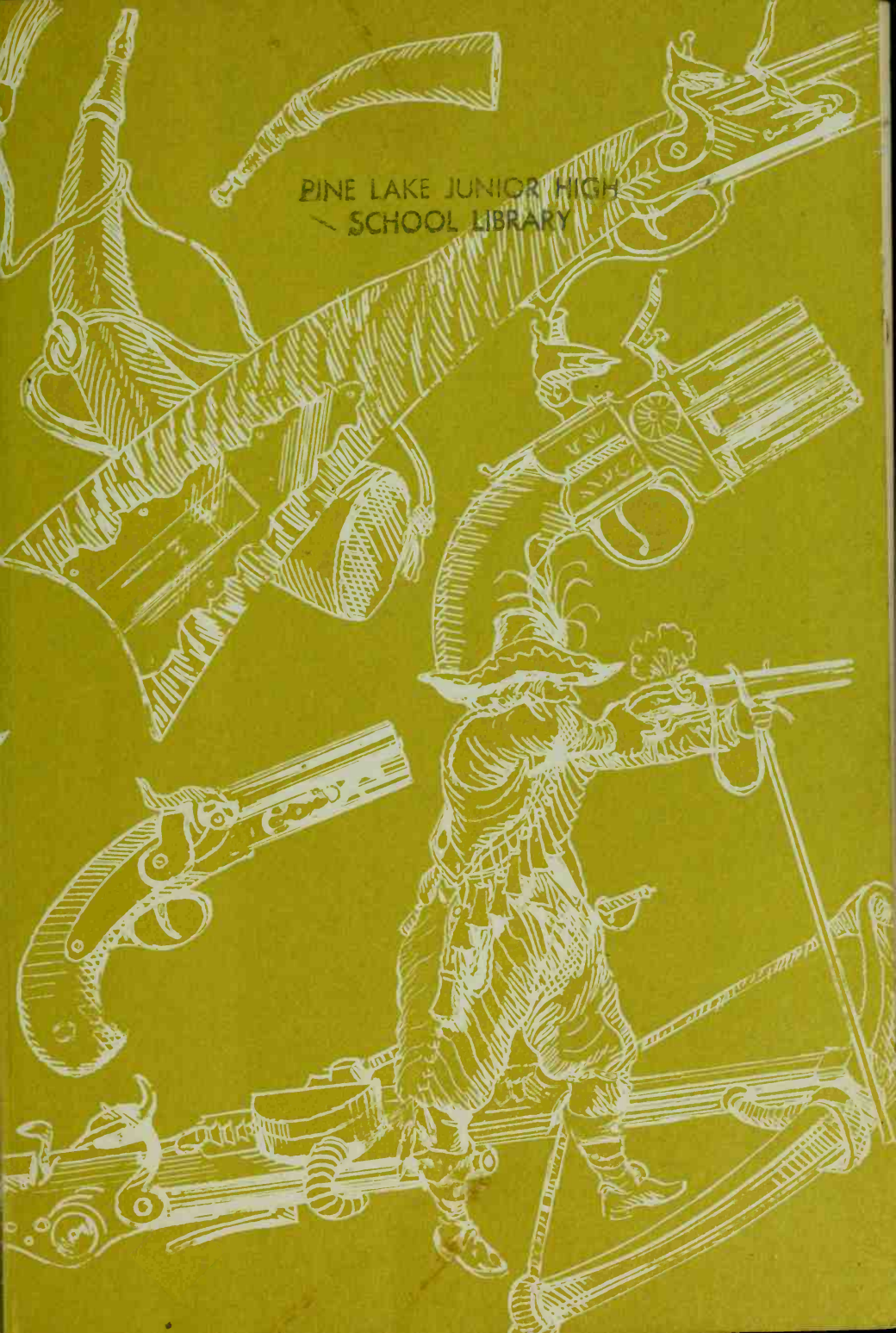
The invention of gunpowder in the middle of the thirteenth century was to make all of man's previous weapons obsolete and start a new era in history. In words and pictures, Mr. Buehr now tells the whole story of how modern weaponry developed—from the earliest mortars and primitive firepots to the latest intercontinental missiles and anti-missiles. He pinpoints the most important advances in design and use, and shows how these affected military tactics, changed people's daily lives, and revolutionized their social and political institutions.

Cannons; handguns of all kinds, both for fighting and hunting; rifles and pistols; field guns and machine guns; many kinds of naval ordnance; and the great breakthroughs in ballistics and rocketry, which today signal the dawn of another era, are described and illustrated in superb line drawings, which clearly depict their separate parts. Mr. Buehr explains how each weapon was made and used; he identifies their inventors and gunsmiths; he sketches the dramatic historic battles in which they were decisive.

American firearms are present in all their variety, from the pilgrim's matchlock and the pioneer's long-barreled Kentucky rifle to the deadly little derringer pistol dear to the riverboat gambler, the Colt "peacemaker" that helped to win the West, and the Thompson submachine gun, better known as Al Capone's "tommy gun." Here is the intriguing account of the "lost" Ferguson rifle, an early breechloading gun that might well have turned the tide of the American Revolution in Britain's favor, and the tale of the Spencer repeater, in-

(continued on back flap)





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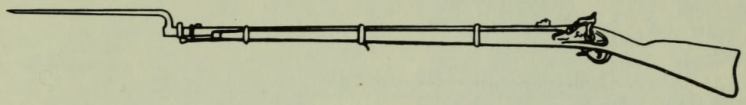

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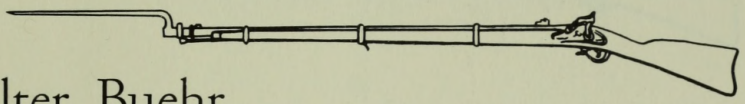

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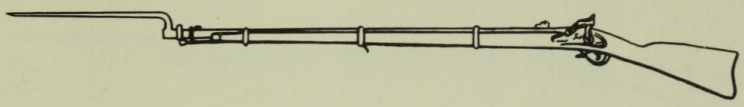


1 The Evolution of Firearms

Warriors' Weapons is an illustrated history of pregunpowder arms. This book continues the story of the development of weapons through the Age of Firearms. It is not simply a weapons catalog, nor does it attempt to describe in technical detail all the variations in gun design since gunpowder. It does try to describe every revolutionary breakthrough in weapon design and tell how each influenced the social, political, and colonial activities of nations all over the world and affected the way of life of their people.

Before the invention of the firearm most of the civilized world lived under the feudal system built up during the Middle Ages. Headed by a king, it was a cohesive chain of authority in which every peer, from the most junior knight to the highest ranking duke, paid fealty to his suzerain or liege lord, from whom he held his fiefdom.

The nobles were the only class trained in arms and able to afford swords, suits of armor, and massive war horses. No rabble of untrained, unarmored villeins armed only with pikes or scythes could stand against the thunderous sweep of a line of armored knights. It was the firearm that was to dispute and then finally destroy the domi-

nance of the feudal knight over the rest of society.

Very little is known about the exact time and place of the explosion of the first crude firearm, except that it probably occurred in North Africa or Moorish Spain in the middle of the thirteenth century.

Since this was a time when Europe still stagnated in the morass of the Dark Ages and the sciences were preserved by the Mohammedan nations, it was natural that the firearm was first developed by Arab scientists and engineers.

The early cannon, which came before other firearms, were effective in battle mostly because their smoke and flame and thunderous explosions frightened the knights' horses, the peasant pikemen, and even the knights themselves. At first the stone balls they threw caused little damage to the soldiers and even less to sturdy castle walls. The attackers continued for some time to batter down the walls and towers with missile throwers like catapults and mangonels, engines that were powered by bent beams or heavy counterweights.

At the battle of Crécy in 1346 the English longbow proved that it could pierce chain mail. Shortly afterward, the first hand cannon, carried by low-born infantry, began to fell the armored knights on the field, and larger cannon breached the walls of once impregnable castles. The feudal knight was no longer invulnerable, and the feudal system began to disintegrate. Although vassal dukes, earls, and other nobles owed obedience to the king, at least theoretically, some strong barons often defied a weak king and ran their domains to suit themselves. The firearm changed this. Cannon and other firearms were extremely expensive and could usually be manufactured only in

foundries in the largest cities, where the powder mills also were. Full-time soldiers trained to handle guns were needed, and feudal barons not only lacked the skill to make firearms but they often scorned these inventions of the devil as beneath a knight's honor. Their vassal knights could not stand against the king's musketeers, their peasants could not supply enough taxes for defense, and inexorably their grim castles crumbled beneath the great stones and iron balls arching from the muzzles of the bellowing bombards.

While firearms thus reduced the power of the unfaithful barons, the central governments grew stronger. The patchwork dukedoms and baronies gave way to national governments with a king ruling the state from a capital city.

But progress in those days was slow. For many years after firearms had been accepted by military commanders, the crudeness and unreliability of those earliest matchlocks kept troops from entirely abandoning the tried-and-true longbow and crossbow. The matchlock, which will be described later, was hard to load and prime; the match, a long hemp wick that had to be kept constantly alight during a battle, was put out of commission during wet weather; and the gun itself was wildly inaccurate at anything more than point-blank range.

Let's compare the performance of the early matchlock with the bow. The crossbow, a weapon shaped something like a gunstock, with its bow (often made of spring steel) fastened to it at right angles, had a range of 475 yards and could drive its short arrow, called a bolt, through steel-mesh armor at 375 yards. Oddly enough, long before the rifled firearm, some crossbow bolts were shot through tubes which gave spin to the missile for greater range and

accuracy. But the crossbow's drawback was its slow rate of fire; even a veteran bowman could seldom get off more than two shots a minute, and the weapon was vulnerable to rain, which stretched the bowstring.

The longbow, favorite weapon of the Welsh and English archers, was six feet long, usually made of yew, and propelled an arrow measuring a cloth yard (three feet) in length. A good archer could loose twelve arrows within a minute and hit a target 240 yards away with each one, but its use required long practice and great skill.

The matchlock had one great advantage that appealed to the army generals. It took almost a lifetime of practice to make a fine longbowman and years of training to handle a crossbow, but a group of raw peasants fresh from the hayfields could be taught to load and fire the new firearms within a few weeks.

But the early matchlocks were also slow in action. A company of musketeers had to be backed and protected by bowmen and pikemen to keep them from being overrun while their guns were being reloaded. Even so, slowly but surely the warriors who had spent a lifetime learning how to handle the lance, the sword, or the bow were outclassed by the new recruits—musketeers who had learned how to fire their matchlocks in a few weeks.

From the fifteenth century, when the matchlock appeared, through the last years of the American Civil War, military tactics had to change constantly because of successive improvements in guns and gunnery. In 1453 the Turks took Constantinople with the aid of great bronze siege guns, and during the Thirty Years War in the seventeenth century Swedish King Gustavus Adolphus' use of field artillery to accompany and support his troops also had to be countered with new tactics.

During the seventeenth century the flintlock, although an enormous advance, still posed problems for the military. The muzzle-loading musket issued to infantry during the seventeenth and eighteenth centuries was fast; its ball was small enough to be dropped down the barrel without being forced down by a ramrod, and a musketeer could get off four or five shots a minute. These guns, such as the English infantry's "Brown Bess," were efficient when used for the purpose for which they were designed. In the intensively cultivated countryside of western Europe there was little cover and battles were fought over meadows and plowed fields. Commanders usually dressed their lines in three ranks, with the first rank kneeling, facing the enemy in full view at less than a hundred yards. At this distance accuracy and range were not important, because one could spray the enemy at close range with many volleys in a short time. If the bullet aimed at a particular enemy soldier struck the fourth man to the left instead, the gunner had no complaint. After the first two volleys the black powder then in use created such clouds of smoke that neither side could see the other anyway.

It was impossible to miss against densely packed ranks at such short distances, and men fell by platoons and had to be replaced immediately by the file closers in the rear while the sergeants bellowed orders to dress the line. At the command to charge, the highly trained grenadiers fixed bayonets, advanced at a walk in formation, and engaged the enemy in hand-to-hand combat. Sometimes they were driven off in confusion; sometimes the attackers were completely destroyed.

Officers were always "gentlemen," a holdover from the days of chivalry, and observed military ceremony punctiliously. It was reported that during one battle the oppos-

ing forces were drawn up in parade-ground formation, facing each other. Politely, one commander invited his adversary to fire, but the enemy colonel, not to be outdone in courtesy, insisted that his opponent fire first. Ceremony having been observed, the muskets roared, men fell in agony, and the battle was on.

Both in England and on the Continent the fifteenth- and sixteenth-century firearm had become more than just a military weapon. The upper classes, who had always enjoyed hunting with sword and spear, commissioned gunsmiths to build them hunting arms for shooting stag, wild boar, and bear. For many years the gentry had scorned bird shooting as beneath their notice and left this game to the lower classes, who thankfully hunted it for the pot. Before the advent of the shotgun birds were stalked and shot on the ground because muskets were too slow and inaccurate to hit them on the wing. Only much later, when the gentry took up bird shooting with fine shotguns, was the etiquette of fowling observed. Hunting guns, usually custom-made and much better than the military pieces, were often beautifully decorated by master gunsmiths and artists.

As firearms became more numerous, governments grew nervous at the possibility that the wrong people might obtain them. It was disturbing to think of mobs of downtrodden peasants or laborers armed with firearms defying lawful authority or of poachers bringing down the noble buck that had always been reserved for the guns of the gentry. Something had to be done.

In 1515, after solemn consideration of the threatening peril, the English Parliament passed a law forbidding, under heavy penalties, anyone but the titled nobility or

anyone with an income of less than two hundred pounds a year to possess or shoot firearms. Those who lived along the Scottish border or the seacoast were exempted from this law because in these areas the king needed a first line of defense.

The law, which disqualified about 93 per cent of the population of England from bearing arms, soon proved, like many such prohibitions, to be unenforceable. The requirement was later reduced to a hundred pounds, but the always stubborn Englishman still continued to hunt in spite of these restrictions.

As guns became more numerous, accidents caused by the bursting of poor-quality gun barrels became so common that the king and Parliament became concerned. Barrels made by reputable gunsmiths seldom burst if properly handled, but careless or unskilled makers often sold bad barrels. Finally, in the 1670's all gun barrels had to be "proofed"—that is, fired with heavier loads than customary—and then stamped by the government.

Until 1750 the best guns were made in Spain. Spanish gunsmiths discovered that barrels made from melted-down old horseshoes were superior to those in which only raw new iron was used because the old metal was much more malleable. In making a fine Spanish barrel, the horseshoe iron was heated, welded, and folded over and over as many as thirty-two times, in the same way that Japanese smiths treated the iron for samurai swords. Finally, horseshoe iron which had weighed fifty pounds at the start was forged into a gun barrel weighing only five pounds; all the rest of the metal had been consumed in the furnace or on the anvil. These barrels were superlative, and the Spanish die mark was pointed to with

pride by the gun's owner. Inevitably, of course, counterfeit barrels with false die marks appeared—barrels that sometimes burst after a few shots.

Ever since their first use in the middle of the thirteenth century, firearms had continued to become more and more necessary to achieve victory in battle. Throughout the sixteenth, seventeenth, and eighteenth centuries the military firearms of the European countries generally kept pace with each other. When one army adopted a new weapon it was not long before the others followed suit. Cannon were first used by Gustavus Adolphus during the Thirty Years War in the seventeenth century to accompany and support troops in the field, and the improvement in mobility and firepower of his field guns had much to do with the spectacular success of the Swedes.

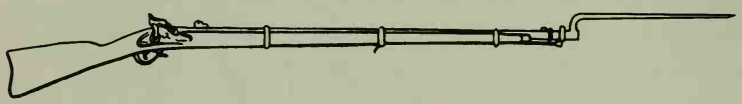
Napoleon Bonaparte employed cannon with great effectiveness during his campaigns at the beginning of the nineteenth century. His batteries of field guns often galloped ahead of the infantry, close to the enemy lines, and poured grape and canister into them to soften them for a French charge. These tactics continued to be effective until the infantry was armed with accurate long-range muskets that could pick off the gun crews before they could fire.

Today guns have become more sophisticated and deadlier than ever. Military small arms give the soldier today many times the firepower of even the rifleman of World War II. Capable of rapid fire and high penetration, they are lighter in weight, almost foolproof, and easy to keep clean and repaired. The Age of Electronics and Space, instead of making the firearm obsolete, has simply increased its effectiveness on land, at sea, and in the air.

The field gun, the rifle, and machine gun, the antiaircraft gun, and the naval gun have been proved to be deciding factors in our military victories in Vietnam. The Age of Firearms, begun seven hundred years ago, is still far from over.

The hand gun or pistol is seldom carried by civilians now, except in the South and West. Only police and gunmen are armed today, but many permits are issued to those who need firearms in their places of business or homes. The rifle and shotgun are still dear to the hearts of many thousands of hunters, skeet shooters, and target shooters, whose powerful gun associations fight bitterly against any abrogation of the constitutional rights of the American to bear arms.

Gunpowder and Ammunition



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A prehistoric man invented the first projectile when he picked up a rock and threw it. Later, some time in the Stone Age, another genius invented the bow and arrow. Incendiary mixtures with and without arrows were used in warfare before Christ. The use of liquid fire is represented in Assyrian bas-reliefs, and Thucydides mentions primitive flamethrowers that were used at the siege of Delium in 424 B.C. According to his account a mixture of sulphur and burning charcoal was blown through a fire tube (a siphon) by bellows and directed at wooden sections of the wall.

After Thucydides, the next important written reference to incendiaries was a collection of recipes for inflammables: the *Liber Ignium ad Comburendos Hostes* (The Book of the Fires for Burning the Enemy), which was translated by a Spaniard from a lost Arabic original and attributed to Marcus Graecus (Mark the Greek) between 1180 and 1225. It described numerous potent incendiaries and crude, slow-burning near explosives. Some even used the basic ingredients of gunpowder but in such impure states and in such proportions that they were not explosive.

The actual discovery of an explosive substance made by mixing saltpeter, charcoal, and sulphur probably occurred in a good many chemist's and apothecary's laboratories, particularly in the Arab nations between the eleventh and thirteenth centuries. But nobody got a real bang out of the combination until its most important ingredient, saltpeter, was sufficiently refined early in the thirteenth century.

The first European to put the formula for true gunpowder on paper was Roger Bacon, Franciscan monk, medieval scientist, and scholar of Christ Church, Oxford. Writing some time between 1240 and 1249, he gave it as 41.2 per cent saltpeter and 29.4 per cent each of charcoal and sulphur. Bacon said that it produced thunder and lightning but he may have been exaggerating a bit because, although his was a true gunpowder, the materials were impure and this mixture could not have been very powerful. He also wrote firecrackers made with it were then in use and added that the explosive power could be increased by enclosing the powder in a casing. He made no mention of using it as a propellant, although it was probably already being used in the first cannon in Moorish Spain.

The Chinese have long been credited with the first discovery of gunpowder and its use in firearms, but most authorities now agree that there are no really good Chinese records to prove that they had guns before about 1350, after which they could have arrived over the land route from Europe. Professor J. R. Partington, a chemist, made a study of original documents and concluded that the Chinese did not know about gunpowder until shortly after it was known in the West. But it still may be a moot point. Wernher von Braun and Frederick I. Ordway in

History of Rocketry and Space Travel mention a Chinese rival of Roger Bacon's, Tseng Kung-Liang, who wrote the *Wu-ching Tsung-yao* (Complete Compendium of Military Classics) in 1045. His book indicates that black powder, and possibly black-powder rockets, was used extensively in the Sung Dynasty (A.D. 960–1279).

The discovery of gunpowder probably resulted from accidental explosions that sent pestles flying from the mortars of a good many thirteenth-century chemists or apothecaries, maiming them in the process.

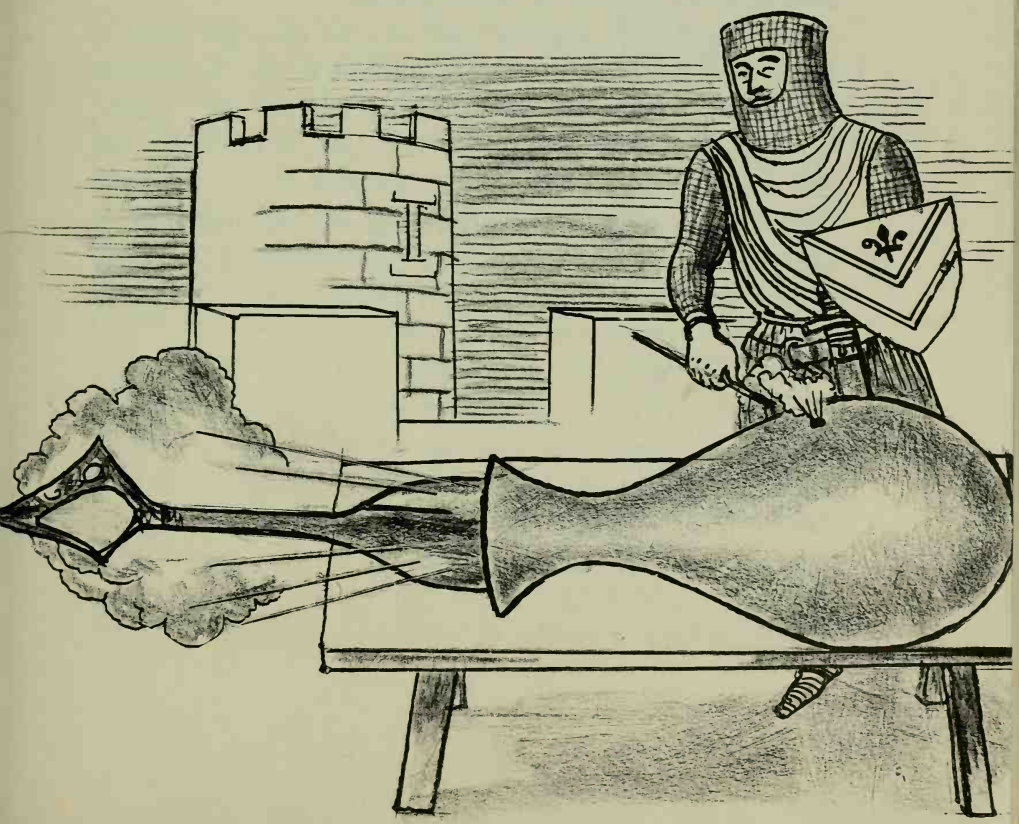
The first firearms using gunpowder probably appeared as early as 1240 or 1250. They were iron buckets (larger versions of the apothecary's mortar) loaded with a pound or two of black powder. A touchhole had been drilled into the breech of the barrel so that the fire could reach the powder behind the missile, and a large rock (the first cannonball) was balanced on the rim or muzzle of the bucket. The weapon was fired with a hot iron or wire pushed down the touchhole.

These thunder buckets or firepots (*pots-de-fer*) could not have been as destructive as the mechanically powered catapults and ballistae, but they were much easier to make, transport, and use. They also provided an early instance of psychological warfare because the flame and thunder of their explosions and the sulphurous clouds of black smoke spread panic among the enemy. The firepots lobbed their missiles over castle moats and walls like mortars. The next step was to achieve a lower trajectory by using a gun with a longer barrel that could be aimed and could batter down and break through a defender's walls.

By 1300 the use of this new weapon spread into Europe and Britain and the bucket shapes began to be replaced

by long tubes called cannon. The first dated illustration showing a cannon appears in a colorful illuminated Latin manuscript, *De Officiis Regum* (On the Duties of Kings). It was written and illustrated by Walter de Milemete, who had been Edward III's chaplain, and the manuscript is dated 1326. His cannon is a three-foot-long vase-shaped tube, and a knight in chain mail is gingerly applying a hot iron to the touchhole. The painting is probably more schematic than realistic because firing it as shown would have been a risky business; there is no provision for absorbing recoil and unless the powder charge was very light, the gun would have been propelled back at the gunner.

A VASE GUN FIRING A BOLT LIKE A CROSSBOW'S



The missile emerging from the Milemete gun is not the cannonball one would expect but an iron arrow with sheet-iron vanes instead of feathers, like a crossbow bolt. Such arrows were wrapped with leather strips to make them fit the inner cylindrical bore; the leather fell off in the air after firing. The earliest vase gun that has been found, probably cast in the mid-1400's, was excavated in southern Sweden. In the same year of the Milemete manuscript the city of Florence ordered some cannons and projectiles. Since the existing manuscript does not give the impression that this was anything out of the ordinary, guns must have been in existence for some time.

Records quoted by Napoleon III in his work on artillery refer to *pots-de-fer* in the royal arsenal at Rouen in 1338 that shot darts weighing six or seven ounces and needed two or three ounces of black powder.

On August 26, 1346, a very precise date for once, a battle took place that brought an end to the dominance on the battlefield of the armored knight and, finally, brought down the curtain on the Age of Chivalry and the whole system of feudalism. Edward III of England, with a force of about twenty thousand men, defeated an army more than twice as large, which included twenty thousand mounted and armored knights led by Philip VI of France, at Crécy in northern France.

Although guns were probably not used during this battle, the victory was gained through a revolutionary advance in weaponry, the use of the longbow, whose rapid fire in the hands of the English archer made it a deadly foe. The short bow that had won the day against the Saxons at the Battle of Hastings in 1066 nearly three hundred years before could not have been fired fast enough to stop a charge of armored knights.

During the two hundred years that followed Hastings (technological advances in those days were slow) the shortbow developed into the far more powerful crossbow, which had to be operated mechanically because it could not be bent back into firing position by hand. Its short iron arrow could penetrate the best armor, and the Establishment tried to outlaw it. The church forbade its use in 1139 except, of course, against infidels, and many armies evaded this interdict by using foreign, imported crossbowmen. Then, in 1215, the Magna Charta outlawed the use of foreign crossbowmen in England.

This happened just as an even more efficient, and less expensive, weapon began to make the crossbow obsolete. The English began to use a longer six-foot bow that could be bent by a hand and yet propel its three-foot arrow into and partially through an oak door four inches thick. The rapidity of fire of the longbow (twelve arrows a minute) often found the joints in the knight's armor, but even more effectively killed their horses and left the heavily armored riders helpless on the ground, waiting for the *coup de grâce.* At Crécy more than half of Edward's men-at-arms were armed with the longbow and they proved its superiority to the crossbow in range, rapidity of fire, and effectiveness. And, more important, Crécy showed without any doubt that tactical combinations of foot soldiers could not only withstand but soundly defeat the repeated charges of those champions of the battlefield—the mounted, armored knights. Philip lost fifteen hundred of his knights in sixteen charges, and he lost the battle—while the English had only five hundred casualties.

Since cannon were already being made and Edward III had some, it is possible that a few may have been used in

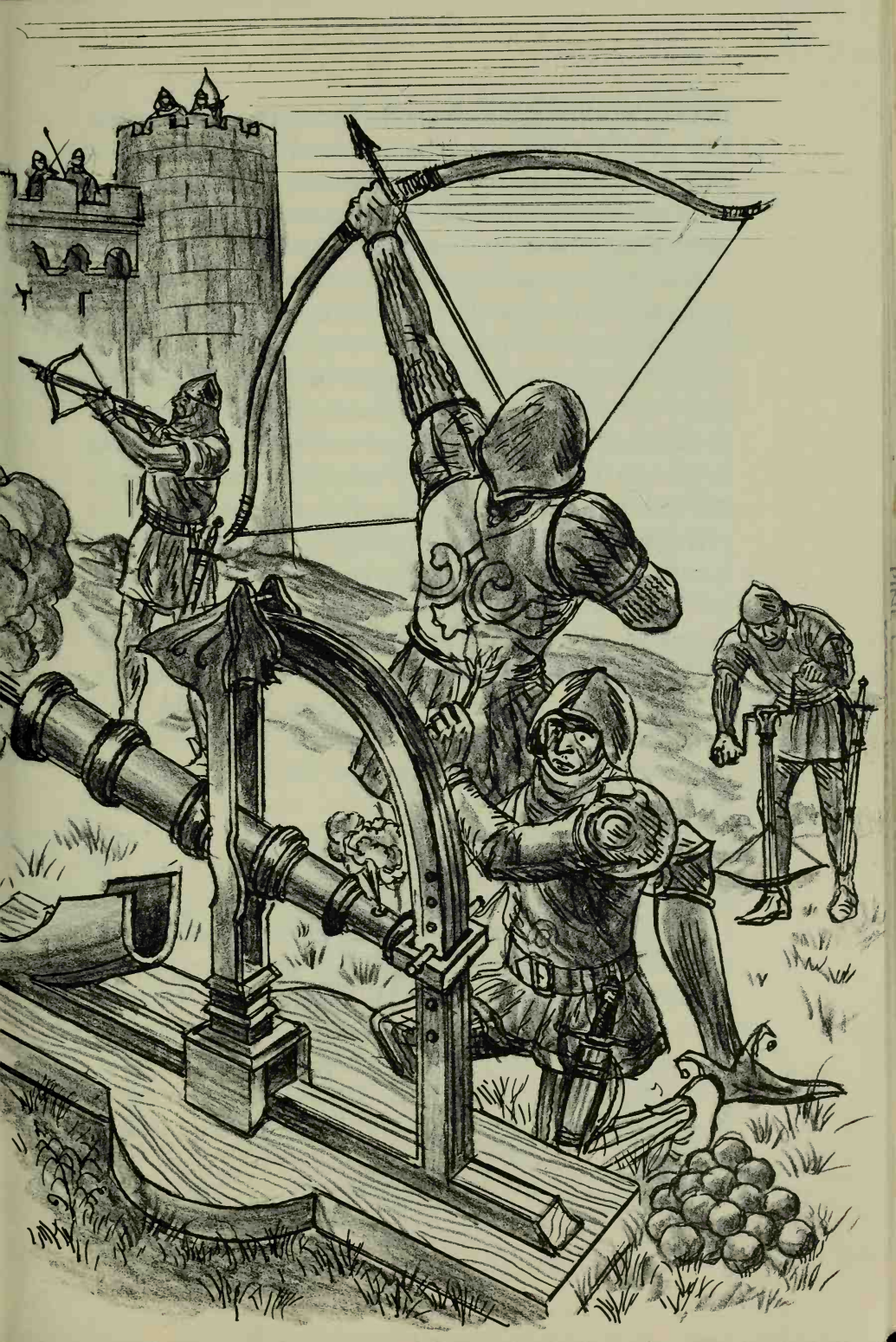
this battle although we don't know for sure. We do know that Edward used about twenty cannon shortly afterward during his eleven-month siege of Calais. The noise and smoke of their explosions and the stone balls they fired into the port helped usher in the new age of firearms. References to cannon, scarce before 1350, multiply rapidly in the next fifty years and by 1400 cannon had become part of every European military establishment.

Foundries were now molding cannonballs of brass, iron, and lead but artillery commanders found them expensive and they hired stonemasons to chisel granite cannonballs. However, the stone balls, cheaper although lighter, were not perfectly round. Cannonball sizing rings were of some help, but a better solution to this problem was a bombard, which could be loaded with stone balls of varying sizes because its bore was conical, wide at the muzzle and narrowing toward the breech.

Stone cannonballs were erratic in action because the irregularities left space between the bore and the ball (windage), which allowed some of the compressed gases to escape. The ball bounced and chattered in the barrel and consequently the range and velocity suffered. Even so, they remained standard projectiles for a hundred years.

Black powder, so called because of its charcoal content, was the only explosive used in firearms for more than five hundred years until the production of smokeless powder in 1884. It depended for its action on saltpeter, or potassium nitrate, a white crystalline salt formed in surface soils as a result of the decomposition of organic matter and often found in cellars and stables. The salt was refined by boiling until almost pure niter crystallized out

EARLY CANNON FIRING STONE BALLS



leaving the impurities behind. Because niter is nearly half oxygen, the powder burns fiercely even in an enclosed chamber and the nitrogen and vaporized potassium oxide are suddenly released with a volume three hundred times greater than that of the unexploded powder.

Early black powder was made by grinding its three ingredients into a fine dust and mixing them thoroughly. Once a charge of this powder was rammed down the bore of a muzzle-loaded weapon, the flame needed to ignite it was fed to it via a tiny vent, or touchhole, drilled in the breech of the barrel. The vent had to be very small to prevent gas leakage and a consequent loss of power. The earliest bombards and hand cannon were fired by poking a red-hot wire into the vent; but keeping a brazier burning during battle was not very practical and someone soon invented the slow match, a fuse of hemp cord soaked in saltpeter and then dried. Hand guns ignited in this way were introduced about 1450 and called matchlocks. The glowing end of the match was held by a clamp in the upper end of an S-shaped arm called, because of its shape, a serpentine, and the powder came to be known as serpentine powder.

The serpentine was pivoted at the side of the breech end of the barrel and when the lower part of the arm was pulled back like a trigger the upper portion carried the glowing end of the match down onto the powder in the touchhole or, later, into a small priming pan containing a small quantity of fine priming powder near the vent. When this ignited it sent a flame down the vent into the charge firing the gun.

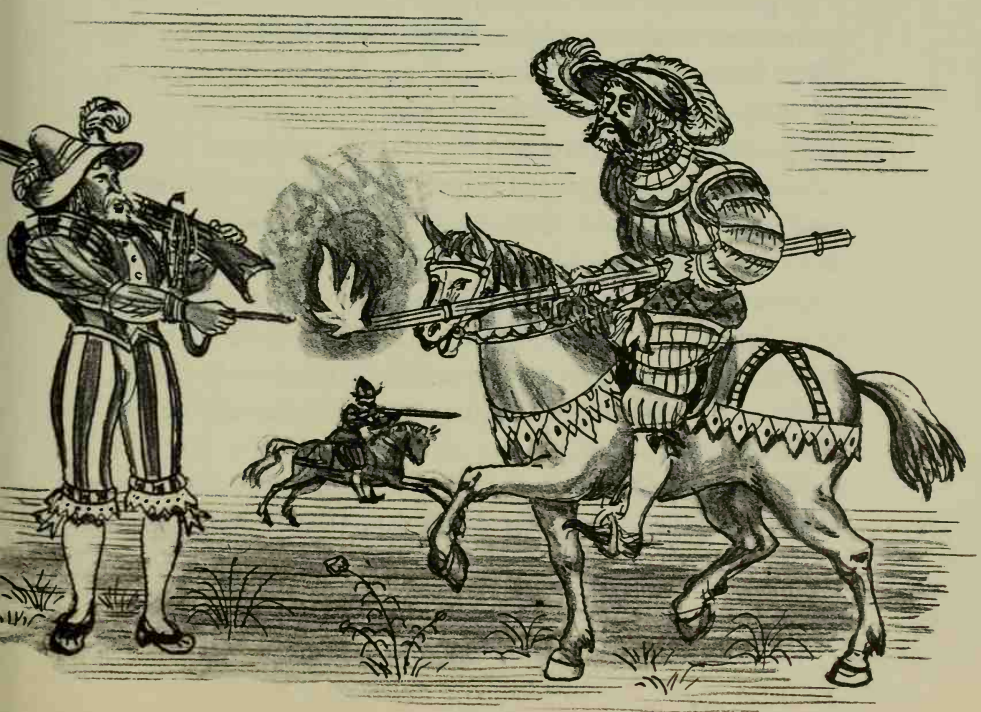
Cannon were also fired in a similar way. Priming powder was poured down the vent, and a lighted slow match,

held in a forked stick called a linstock so that the gunner kept clear of the recoil, was applied to the vent.

This serpentine powder, ground as fine as talcum, was an extremely explosive dust that rose in clouds over the lumbering carts that carried it to the guns and was always in danger of being exploded by passing sparks with disastrous results to the wagon train and any nearby men-at-arms. Even if the powder reached the gun batteries safely the jolting tended to separate its ingredients, the heavier sulphur going to the bottom, the saltpeter to the middle, and the lighter charcoal to the top. This made it necessary to remix the contents of the kegs at the firing line, thus releasing more clouds of dust. Carrying the ingredients in separate kegs tightly bunged was little help since they still had to be mixed at the battery.

Because the use of any open flame near the firing line

SIXTEENTH-CENTURY FIREMASTER



was so dangerous, a mounted firemaster accompanied the artillery but stayed well to the rear. He carried a torch with which to light the gunners' matches and to start cooking fires.

Loading the cannon presented its own problems. If the powder was rammed too firmly down the barrel the flame could not pass through the tightly packed particles and the powder would merely fizzle or not burn at all. If it was packed too loosely, the gases from the explosion lacked compression and might send the ball only a few yards.

Good master gunners with sufficient skill and experience to load the powder properly were in great demand after about 1450. Kings and nobles and most large cities that maintained armies for defense paid them fat salaries and kept them satisfied and loyal with bonuses of gold dust, gifts of the best wines, and choice female companionship.

Serpentine powder also left such heavy deposits of unburned carbon in the gun barrels that loading became difficult after half a dozen shots, and after eight or ten more the fouling had to be scraped and scrubbed out if the gun was to be fired at all.

Serpentine powder was improved in the mid-fifteenth century by a method of mixing the ingredients while wet. Saltpeter, sulphur, and charcoal were ground together in a mortar or stamping mill, and alcohol or water was added to make a paste. Urine was often used by perfectionists, that of a wine drinker being preferred to a beer guzzler's, while a bishop's was thought to make powder of the highest quality.

The paste was dried and pressed into cakes and then broken into fine grains by being rolled in a barrel con-

taining a heavy stone ball or by being crushed in a stamp mill. The grains were sorted by being sifted through various-sized screens.

This process was called corning because the coarsest grains, for cannon, were about the size of corn kernels. Finer grains were used for small arms and the finest for priming.

Corned powder was superior to serpentine in many ways: it produced very little dust, caused much less fouling, and absorbed less moisture on damp days. It also exploded much more violently because the flame from the primer could permeate the grains more quickly and efficiently than it could the fine serpentine powder. Although corned powder was first written about in 1429, it was not much used for another two hundred years because it was *too* efficient. The still imperfect cannon barrels were not strong enough to withstand the sudden violence of a corned-powder charge that was heavy enough to propel a ball any distance. So many cannon blew up, killing their crews, that it was more practical to continue to use serpentine. It was not until the late sixteenth and early seventeenth centuries that foundries learned how to make cannon barrels strong enough to use corned powder safely.

Its use in small arms spread throughout Europe. Compared with cannon the barrels of the first, matchlock *arquebuses* were stronger in relation to the small quantities of powder used—a half ounce to an ounce and a half against a charge of several pounds for cannon.

Corned powder could be delivered to the guns with less danger of premature explosion, but if it was damp it would not explode at all and in battle this was even more catastrophic. Early powder magazines were built with floors several feet above ground, the space below

being filled with stone chips or sea coal to avoid dampness, and containers of chloride of lime and charcoal were hung inside to absorb moisture. The walls contained ventilator windows carefully barred and screened to keep saboteurs from thrusting cats with their tails set afire through the ventilators as mobile torches to explode the magazines.

The individual powder container used by soldiers and hunters carrying the fifteenth-century arquebuses was a flask of leather, wood, or metal with a stopper, often lavishly decorated. Later on musketeers carried their powder in the powder horn. This was a hollowed-out cow's horn with a stopper at the narrow end and a tight wooden plug at the other, and it was slung from a cord over the shoulder. The gunner also usually carried a smaller horn filled with finer powder for his priming pan. The shooter poured as much powder from his horn down the barrel as he thought it needed for the range of his target, then dropped the ball down with paper wadding on top of it to keep it from rolling out. Sometimes the guesswork about loading was removed by the use of small wooden bottles, each containing a measured charge of powder, that were carried hanging from a necklace or bandolier.

Artillery crews brought loose powder to the gun in leather buckets with wooden covers and the loader removed as much powder with a long-handled ladle as he thought was needed to propel the ball to its target without blowing up the barrel. He would thrust the ladle to the bottom of the bore, twist its handle, dump the charge, and withdraw it. Then the cannonball was rolled down the barrel and a cloth or paper wad was rammed down on it.

Iron and brass cannonballs until the sixteenth century

WOODEN BOTTLE POWDER CHARGES CARRIED BY ARQUEBUSIERS

were always solid, but at the close of the fifteenth century (1495) the Dutch invented the hollow explosive shell. It was filled with a charge of black powder and a fuse of hardened powder was screwed or driven into a small hole in the shell casing with its tip projecting. The length of this fuse determined the timing of the explosion. When the cannon was fired the flame of the discharge lighted the fuse and, when it reached the powder, exploded the charge.

Besides the bolts and stone, iron, and brass cannonballs, a good many different kinds of missiles were expelled from gun muzzles. Sometimes in naval warfare two cannonballs joined together by lengths of chain (*chain shot*) or by two solid bars (*bar shot*) were fired at once and whirled in the air like Argentine bolas. *Knifeblade shot* had hinged blades that flew open on discharge. These were all used for cutting the rigging of naval vessels. *Grapeshot* was small round balls contained in a wooden case that burst open in the air and flung its missiles in all directions, and *canister shot* was literally a can filled with small shot that acted like a grenade. Grape and canister were used against closely packed masses of men.

In both land and naval batteries during the muzzle-loading days fires in enemy forts or ships were often started with *hot shot*. Solid iron balls were heated white-hot in portable furnaces set up not far from the guns. The gun was charged with a wooden tampion rammed down on top of the powder to keep it from exploding too soon. Then the glowing hot shot was carried in a pair of tongs to the gun and rolled down the barrel. Flame from the vent reached the powder and then exploded the charge before the hot shot could.

In the late 1400's, Leonardo da Vinci suggested the use

of preloaded cartridges of paper (the word cartridge comes from *carta,* meaning paper), complete with ball and powder and tied at both ends, and they came into use before 1550. Whitehorne in 1650 described "bagges of linen or paper with powder and shotte" for cannon. The gunner pierced these cartridges by pushing a sharp pricker down the touchhole so as to expose the powder to the primer flame. Sometimes tin tubes or goose quills filled with priming powder were also pushed down the vent into the cartridge to speed up priming. Cartridges were made of wool, canvas, linen, parchment, or flannel, but none of these was completely consumed in the explosion. As a result, after a few shots so much unburned material remained in the breech that it had to be removed by a corkscrewlike tool called a worm in order to keep the vent open. It was not until silk was used about 1780 that a really satisfactory cartridge was made.

Later the primer was ignited by a flint that gave off sparks when the gun captain pulled a lanyard. In small arms the use of a flint striking sparks from a steel plate led, about 1510, to the *wheel lock,* the Dutch *snaphaunce,* or *snaphance* (1520), the Spanish *miquelet* (1550), the *musket* (1590), and finally the true *flintlock* (1630).

Other ignition methods followed: the *percussion lock* (1807), the *rim-fire cartridge* (1835), the *pin-fire cartridge* (1836), and the *center-fire cartridge* (1861).

It had been known since the 1750's that such chemical compounds as fulminate of mercury and silver, and gunpowder made with potassium chlorate (instead of nitrate), would explode violently when struck with a hammer. The Reverend Alexander Forsyth of Aberdeenshire, Scotland, developed this principle as a means of igniting the powder charge of a gun shortly after 1800 and obtained a

patent for it in 1807. He thus relegated all the eighteenth-century guns with their clumsy, often unreliable flintlock mechanisms, striking steels, and flashpans to the museums. This was such a vast improvement that within twenty-five years the flintlocks had all but disappeared from Europe.

Various other inventors then worked on Forsyth's idea and cleared the way, eventually, for another enormous step forward—the metal cartridge patented in 1836, which contained primer, charge, and bullet in one container.

When the percussion cap was incorporated into the base of a brass cartridge with the powder charge and the bullet in front of it all in one package, the gun could not only be loaded and cocked in one motion, but the revolver, the repeating rifle, the machine gun, and the quick-firing cannon became possible. Later, even cannon of up to three-inch caliber were built to fire such self-contained brass cartridges.

The black powder in use for centuries, which quickly fouled the gun barrels, caused tremendous clouds of smoke, and exploded too suddenly, was eventually replaced by a slow-burning powder for cannon that could produce an increasing pressure of gas while the projectile was still in the gun instead of releasing it all at once in the breech. This not only put more drive behind the ball but reduced the sudden pressure on the breech and distributed it along the barrel more evenly, making it possible to reduce the gun's thickness and weight. This was achieved by pressing the powder into discs or cakes an inch or more thick and piercing them with holes like a Swiss cheese. Less surface was exposed at the beginning of the detonation, but as the flame enlarged the holes the gas volume gradually increased.

In 1845 black powder began to be superseded by a completely different explosive—guncotton. Ordinary cotton, a harmless cellulose until it is steeped in nitric acid and dried, becomes a powerful explosive that can be chopped up into granules to make a powerful smokeless powder. At about the same time Alfred Nobel learned how to mix nitroglycerine with absorbent earth to produce dynamite and this, with nitrocellulose, produced another type of smokeless powder.

By the middle 1800's when gun bores became rifled, the cannonball acquired a new shape—the first improvment in cannon ammunition since the 1400's. The shell became cylindrical with one end pointed and with a copper rotating band that engaged the rifling at the other. This gave the cannon much greater accuracy and longer range. Later, armor-piercing noses and delayed-action fuses made it possible to explode the shell deep inside a fortress or warship, and the modern version of canister—shrapnel—became a formidable antipersonnel weapon.

A weapon that does not hunt its target but waits quietly until the target comes to it is the *mine*. It has been used for centuries but became much more important beginning with World War I. At sea, mine fields wait for enemy shipping and explode either when they come into contact with a ship, magnetically, or by being fired from a distance electrically. On land they may be placed under an enemy strong point by tunneling or being scattered along the routes the enemy is expected to use or in fields they may have to cross.

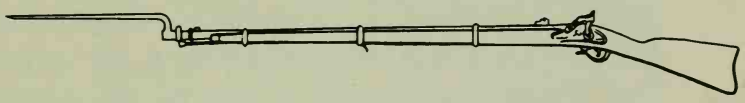
Today the motive power of many projectiles such as the naval torpedo and the rocket is contained in the missile itself. Some of these, such as the magnetic torpedo and

the heat-seeking rocket that homes in on its target no matter what evasive action the defender takes, make modern warfare a complex battle of electronics.

By World War II all nations were using some form of smokeless powder, such as ballistite or cordite, and the dense clouds of smoke that had long shrouded battlefields became a thing of the past.

The World War III ultimate weapon—the intercontinental ballistic missile with its atomic warhead—would make the whole world one vast battlefield in which there would be no victor.

3 Cannon



One might think that the first firearms were small hand guns from which the cannon developed. Just the reverse is true. The mortar, a type of cannon, came first, followed by portable hand cannon from which a variety of small arms evolved.

Tube-shaped firearms appeared at about the time Milemete painted his vase-gun picture, but the word cannon isn't found until about 1400. It derives from *canna,* the Latin word for reed and the French for tube. After the mortar-shaped *pot-de-fer,* called a *vasa* (vase) by the Italians, that arched its missile over castle walls, a tubular shape was developed, which enabled the gun to be fired horizontally to batter walls at point-blank range. Although the first mention of cannon is in the 1326 Florentine decree no one knows for sure just when or where the first tube-shaped cannon were fired. Possibly this took place in Cividale, Italy, in 1331, but references to them become more numerous through the next ten years.

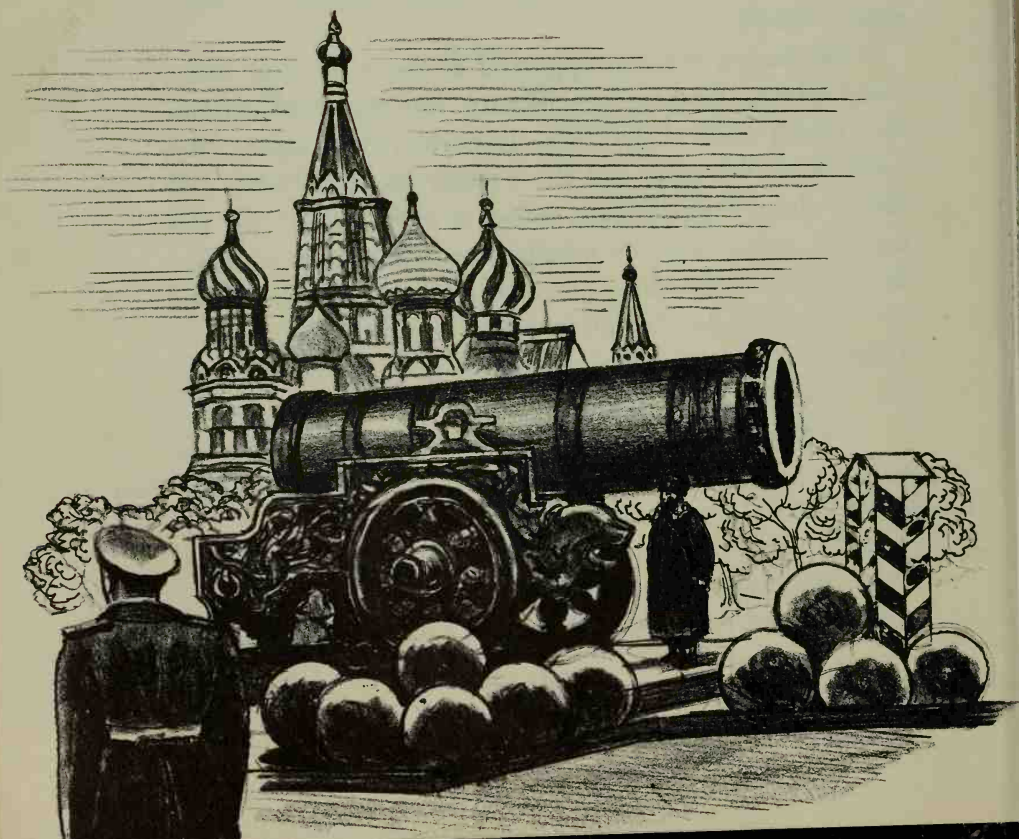
In the mid-fourteenth century cannon ranged in weight from fifteen and twenty-five pounds up to one hundred to three hundred pounds. Heavy cannon were stationary

and their barrels could not be moved laterally (traversed) or up and down (elevated). Their gunners led short lives because the methods of making gun barrels were so primitive that as the strength of the gunpowder increased, more and more of the guns blew up. One such explosion killed James II of Scotland in 1460.

These muzzleloaders were usually lashed or bolted down on heavy plank bases and loaded with loose powder and with brass, lead or iron balls; the larger cannon were loaded with stone missiles. At first the barrels were cast of bronze or brass.

The heavier cannon, or bombards, were given greater mobility when the Swiss mounted the wooden bases on

THE MORTAR OF MOSCOW



wheels, and about the same time someone added axles (trunnions) at the barrel's center of gravity on both sides so that the gun could be elevated.

The designers of cannon began making them bigger and bigger until by the fifteenth century some had become giants. As early as 1382 an enormous wrought-iron bombard was built called "Mad Margaret." Still to be seen in Ghent, it weighs 33,606 pounds, has a barrel 33 inches in diameter with a 20-inch bore, and hurled a 600-pound stone missile. The Dardanelles Gun, now in the Tower of London, was part of the armament of Mahomet II, Sultan of Turkey, during the siege of Constantinople in 1453. Seventeen feet long, it weighs over seventeen tons and is said to have propelled a thousand-pound ball almost a mile. The Russians hold the world's record for the largest-caliber cannon—the great Mortar of Moscow. Built in 1525, it is eighteen feet long with a thirty-six-inch bore, but it was never fired in battle! Monster cannon like these were used mostly as fortress armament or during long sieges because their great weight made them difficult to drag into position. Even then they could only be moved on level terrain.

Hand cannon began to be used about the late 1300's; they were simple iron tubes weighing from four to fifteen pounds and were from three to twelve inches long with calibers ranging from less than half an inch to two inches. These were the first small arms.

First, a four– or five–foot long wooden shaft that projected from the breech was added to the barrel to keep the gunner from being burned by the explosion. This stock was either held under the arm or pushed into the ground to help absorb the recoil. Loading by the muzzle was

awkward, and gunpowder in the early 1400's was sometimes so weak that three-fifths of the barrel had to be filled with it. This left little bore for the ball to travel through, and was almost no help at all to its accuracy, and since the gunner had to watch as he pushed the heated wire into the touchhole he couldn't look in the direction he was shooting. If he hit what he intended to he was lucky. In spite of this, the hand cannon were a great step forward; they were portable, which was such a great tactical advantage that gunsmiths strove to improve the weapons.

Unlike heavier cannon, these hand weapons had considerable mobility. This encouraged gunsmiths to make improvements such as lengthening the barrel for accuracy, carving the stocks into more convenient shapes for aiming, and finding better ways to ignite the charge than by heated wires.

Hand cannon were also inexpensive; one weighing fifteen to twenty pounds cost about six or seven shillings at a time when a great crossbow cost more than sixty-six shillings. But they were powder eaters. The blast of flame that must have issued from their muzzles probably inspired their name—"fire sticks" (*bastons-à-feu*). They are first mentioned in literature as early as 1371.

Cannon light enough to be moved but large enough to demolish forts were dragged to within a hundred yards of the walls, making the gunners vulnerable to enemy crossbowmen. To protect them, frames were built over the guns on which heavy wooden shields balanced on pivots were mounted. While the gun was being loaded, the shield was tipped forward to cover the gunners and then tilted back to clear a path for the ball.

Master gunners were often civilian professionals who sometimes even owned their own cannon, which they rented out along with their services to the highest bidder. They often gave fanciful names to their cannon, such as "The Messenger," "The Kyng's Daughter," or "The Thunderer." In 1415, before the battle of Agincourt, Henry V carried on his rolls four master gunners, each of whom had under him two servitor gunners and twenty-three ordinary gunners.

Cannoneers were a special class, and they usually avoided ordinary soldiers, who looked upon them with deep suspicion because they did not drink, carouse, or plunder. In addition to their fat fees they demanded the right to any metals captured, from church bells to iron gates, that could be melted down to sell or to make more gun barrels. They kept the tricks of their trade a deep secret and their guild was difficult to join.

Casting perfect iron gun barrels was beyond the skills of the founders of that day. Because poor casting caused barrels to burst, cannon were usually built in what seems today a very unlikely way. Bars of iron were laid side by side around cylindrical wooden cores and welded together by heat and hammering, after which the wooden core was burned out. Melted lead was poured into the cracks where the welding failed to make a tight joint, but such barrels were still too weak to withstand an explosion inside. Iron hoops just large enough to slide over the barrel when they were heated red-hot were slipped along the barrel at intervals and shrank tightly around it when they cooled. A cooper's wooden barrels were made in much the same fashion except for the shrinking metal; this may be why cannon (and gun) "barrels" were called that.

Strangely enough, the breech-loading firearm, usually thought of as a modern invention, was tried early in the fifteenth century. Breechloaders had one great drawback which the mechanics of that day were unable to correct. The breechblock could not be made close-fitting enough to prevent serious leakage of the exploding gases, which reduced the gun's range and power as well as endangering the crew. For this reason the idea was abandoned for more than a hundred years—until 1704.

There were several types of breech mechanisms. In one the top half of the gun breech was cut away for about a foot and a separate breech chamber with a handle, looking like a beer stein, was loaded with powder and ball and fitted into the opening. A flange on its front end was wedged against the barrel of the gun, and the chamber turned, locking the breech into place.

In another type, the breech chamber was fitted into the open rear end of the gun barrel in the same way and held securely by a heavy wooden wedge driven in between the rear of the breech and a backing block. However, only a screw-thread breech can assure a really tight fit, and making this was beyond the mechanical ability of early gunsmiths.

During the first half of the seventeenth century some rather odd materials were used to make gun barrels. King Gustavus Adolphus, the great artillerist, was one of the first to realize that a cannon should be mobile. He had gun carriages made with split trails and larger wheels so that they could be hauled at a gallop by horses instead of by slow oxen, and he decreed that his field guns would be no heavier than twelve-pounders. He also demanded lighter guns and had some made of leather! These cannon

were so light that one required only two men to haul and serve it. The gun had a chambered brass breech that screwed into a wrought-copper tube wrapped with wire and covered with a layer of carefully wound rope that was coated with plaster to smooth the surface between strands. A jacket of boiled leather was then slipped over this, which shrank and fitted tightly when it dried. One of these cannon was 6 feet 5 inches long, with a bore of 2.17 inches, and weighed only 120 pounds. Apparently these leather guns gave good service.

European gun founders next made stronger barrels by twisting the iron bars around a core and welding them instead of using lengthwise strips. Then early in the 1700's an even better way of making gun barrels was discovered in Holland. Instead of building metal around a core, the Dutch began drilling out the bore in a solid casting; this made a truer, stronger gun with far fewer flaws. A length of rope or plaited straw was wound around a shaped wooden core and hammered to make the strands fit tightly. This surface was then covered with a layer of fine clay, brickdust, and grease. The raised axles, or trunnions, which enabled the gun to be elevated, the cascabel, or knob at the breech, and the slight flare of the muzzle were carefully molded in the clay. The plaster was then poured around this core to make two half molds. Melted bronze or iron was poured inside the joined half molds and left to cool. Later a drill, turned by a great wheel or a treadmill, bored through this solid barrel to make a clean, even bore. This new method was used until the mid-nineteenth century brought the built-up gun barrel.

Although eighteenth-century cannon were all cast, the rings around the barrels, which were now purely decora-

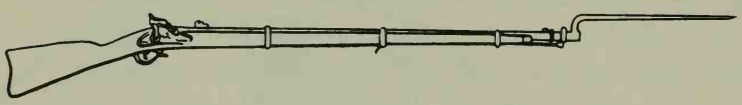
tive, made them look like the earlier guns. Many of the seventeenth- and eighteenth-century gun barrels were embellished with elaborate decorative designs—coats of arms, wreaths of flowers or leaves, scrolls, and raised inscrip-

DRILLING THE BORE OF A CAST-IRON CANNON

tions in Latin giving the name of a monarch or of the gun. Even the cascabel and handles by which the gun was hoisted were often shaped like gargoyles, dolphins, or dragons, and famous artists were engaged to model these designs. Eventually such decorations were abolished to lighten the gun and reduce the cost.

Over the years cannon became more and more important, especially at sea, where the ships that carried them supplied more mobility. Great technical advances were made in their manufacture in the nineteenth century and the race to make them ever more effective has continued to the present day.

Naval Ordnance



4

Naval cannon have played an even more important part in the shaping of the history of the world than land cannon. On land, cannon were sometimes secondary to the massed men armed with muskets or rifles, but a sea battle was almost always decided in favor of the side that could put the enemy out of action with the superior firepower of its cannon.

In the tenth century a fleet of Vikings sailed out of the Dnieper River, crossed the Black Sea, and attacked Constantinople when the main Byzantine fleet was absent. The Byzantine admiral on duty hastily fitted out his few remaining galleys with a primitive kind of cannon—tubes that expelled Greek Fire, an incendiary mixture used by the Byzantines. He met the Viking galleys and rained such flaming destruction on them that they abandoned the attack and fled in terror.

War galleys existed in the Mediterranean even before the great days of Greece and Rome. In the fourteenth and fifteenth centuries, after the Crusades, there were constant raids and skirmishes between Christian galleys

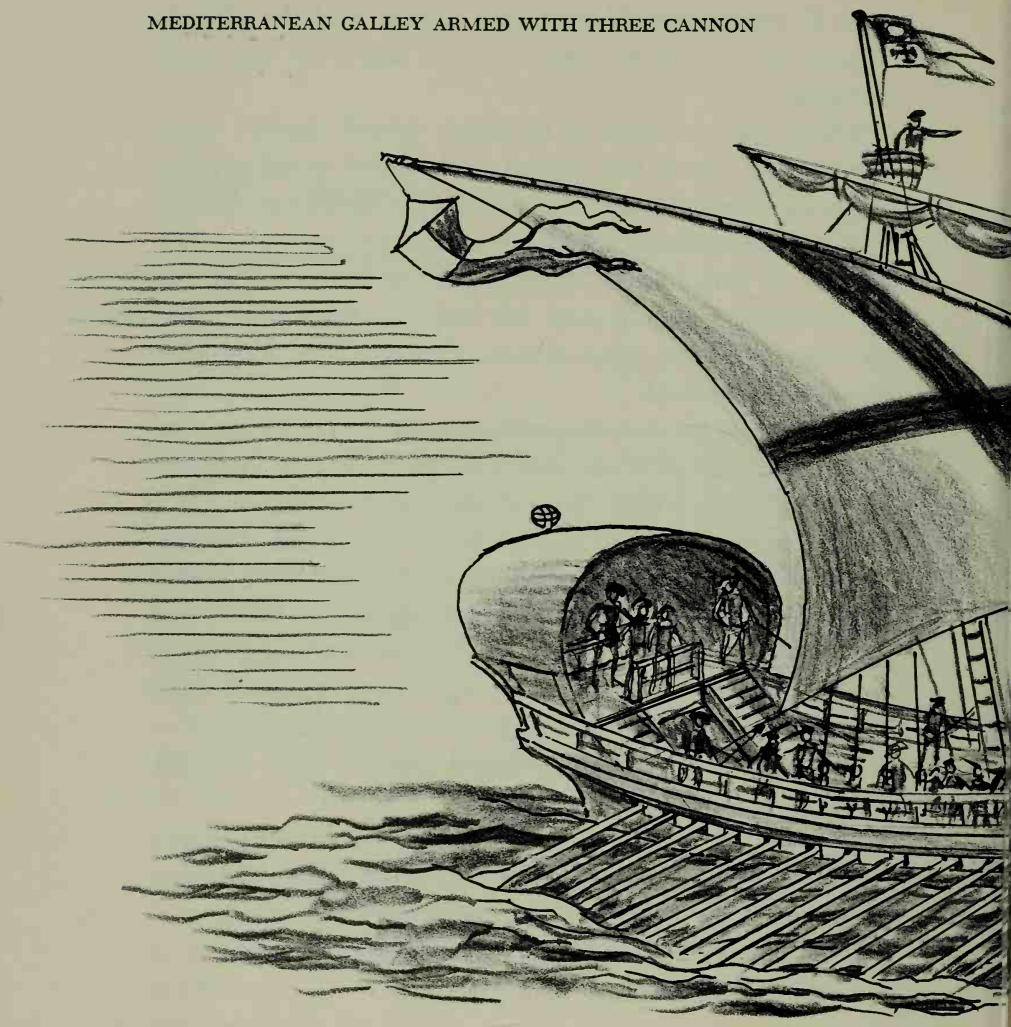
from Cyprus, Crete, Venice, and Austria and the Moslem ships from the eastern and southern shores of the Mediterranean.

These galleys carried ballistae, which hurled huge stones and casks of burning oil, and carried metal projecting rams. Their crews were armed with crossbows, lances, and swords, and the usual tactic was to ram the enemy and try to sink him or, failing that, to fasten on to him by throwing grapnels over his rail and then board him for a hand-to-hand fight—a tactic that was used long after gunpowder arrived.

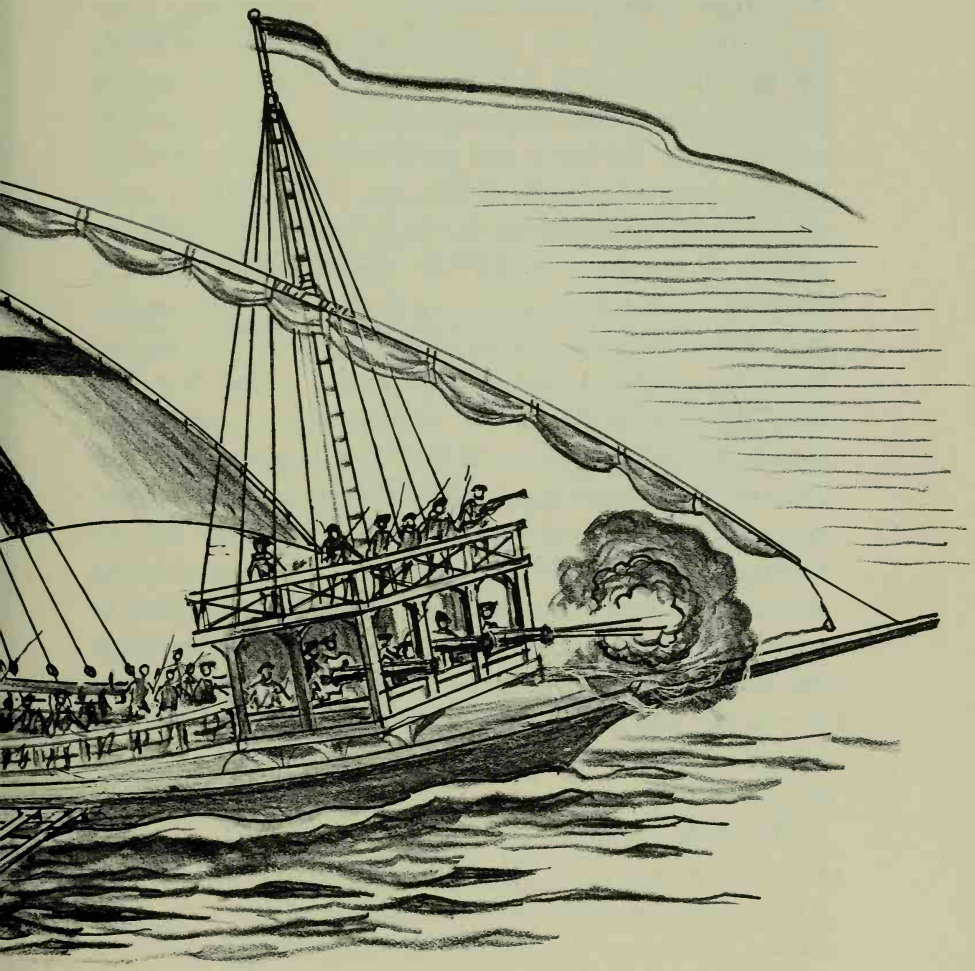
In the early fourteenth century cannon went to sea. The barrels of these early cannons were so badly cast that they could take only a small powder charge, they did not have much range and their missiles were very small. Because they were not powerful enough to damage the wooden hulls the cannon were used mostly against the crews of enemy ships. The barrels were fastened by metal straps or ropes to heavy wooden bases that were lashed to deck bolts. There was no provision for recoil, traversing, or elevation, but the powder charges were so light that the recoil problem was not serious.

Builders of prefirearm ships erected towers at the bows and sterns of all round ships, called fore- and sterncastles, from which archers and spearmen could hurl down missiles upon an enemy's decks. Even merchant ships had to be armed for protection against pirates and raiders. These elevated castles were the most logical places to mount the new cannon; from them they could sweep an enemy's decks and fire on any boarding party. This custom continued until cannon increased in size and weight and began to make ships top-heavy. Also the lack of space on the

MEDITERRANEAN GALLEY ARMED WITH THREE CANNON



castles limited the number of guns a vessel could carry. In 1541, it finally occurred to Henry VIII's chief shipwright to cut gunports in the ship's rails and mount rows



of cannon on the decks. These were the first of the sailing warships that would rule the oceans for three hundred years.

The armament of early naval ships consisted mostly of small brass guns of various calibers in rather large numbers, although the total weight of their missiles was small. By the mid-fifteenth century cannon began to appear aboard galleys. The larger guns were always mounted immovably in the bows and could only be used when the ship was pointed straight at the enemy. The galley's armament usually consisted of one large gun mounted in the middle of the bow, called the *corsier,* which threw a thirty-six–pound ball, and was flanked by two smaller guns called *batardes,* twenty-four-pounders, and beyond them two eighteen-pounder *moyennes.* Along the rails were rows of four-pounder breechloaders mounted on swivels to repel boarders. Later, the bigger guns were mounted on recoiling carriages and could be traversed and elevated. In 1488 Henry VII had built the 600-ton *Sovereign* armed with 180 guns, mostly serpentines with one-and-a-half-inch bores. Later, the English decided to arm ships with fewer but heavier guns, and the *Sovereign* was rebuilt in 1509 and given a new battery consisting of four whole and three half *curtals* of brass, three *culverins,* two *falcons,* and eleven heavy iron guns, weight not specified.

The early sixteenth century saw the construction of several towering great ships ordered by Henry VIII. *The Henry Grace à Dieu,* or *Great Harry* as she was nicknamed, was one of the last in which cannon were mounted in the castles.

This listing of the *Great Harry*'s guns from *The Letters and Papers of Henry VIII* gives the names of the sixteenth-century guns and it also lists a wide variety of calibers:

TYPES	GUNS	BORE	PROJECTILE
Brass barrels	4 cannons	8½″	60 lb.
" "	3 demi-cannons	6¾″	32 lb.
" "	4 culverins	5½″	18 lb.
" "	2 demi-culverins	4 ″	12 lb.
" "	4 sakers	3½″	

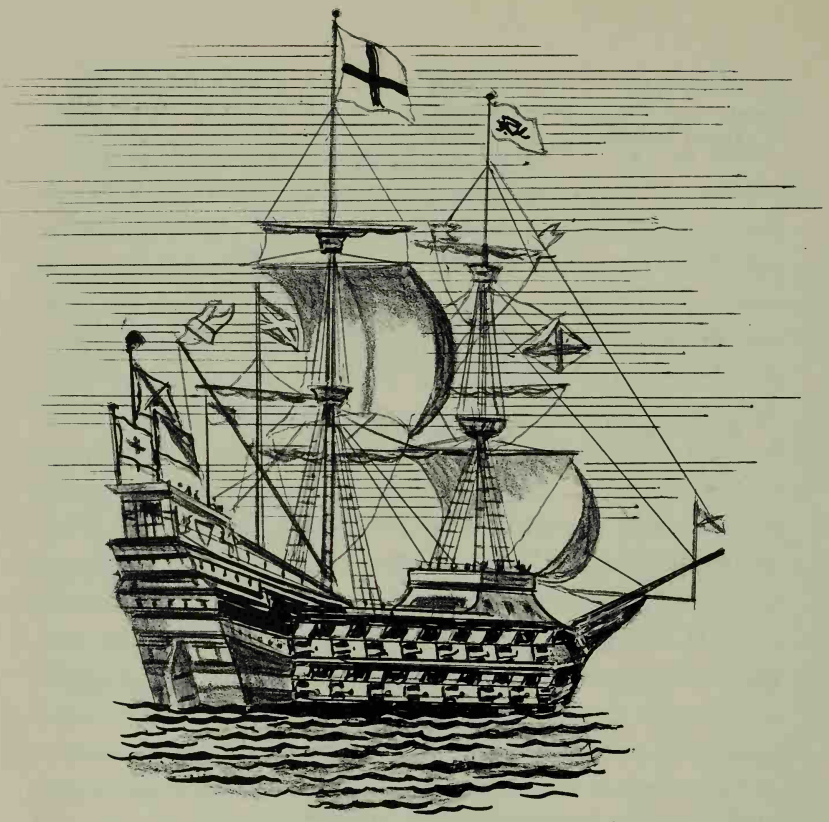
Guns below are 3, 2, and 1 pounders in size, which threw stones instead of balls:

Brass barrels*	2 cannon-perrers	(murthering pieces [small guns] used against enemy crews)
" "	2 falcons	
" "	4 port peceys	
" "	8 fowlers	
Iron barrels	2 demi-slings	
" "	4 slings	
" "	60 basseys	
" "	2 toppe peces	
" "	40 hayle shot peces	(all these very small)
" "	100 hand gonnes	

*These names had a variety of spellings, such as perrer, also spelled perrier, patterere, pieriere, or peterara.

In carracks, caravels, and galleons, and later in frigates, ships-of-the-line, and sloops of war, armed with one, two, or three rows of frowning cannon, the seafaring nations of Europe battled for supremacy and sent out expeditions of conquest and colonization to the ends of the earth.

Although he was not a navigator and had accompanied none of the Portuguese voyages of discovery, Prince Henry of Portugal was called the Navigator because he *was* the moving spirit behind the first of the great European explorations. He sent out his first small expedition,



PORTUGUESE CARRACK

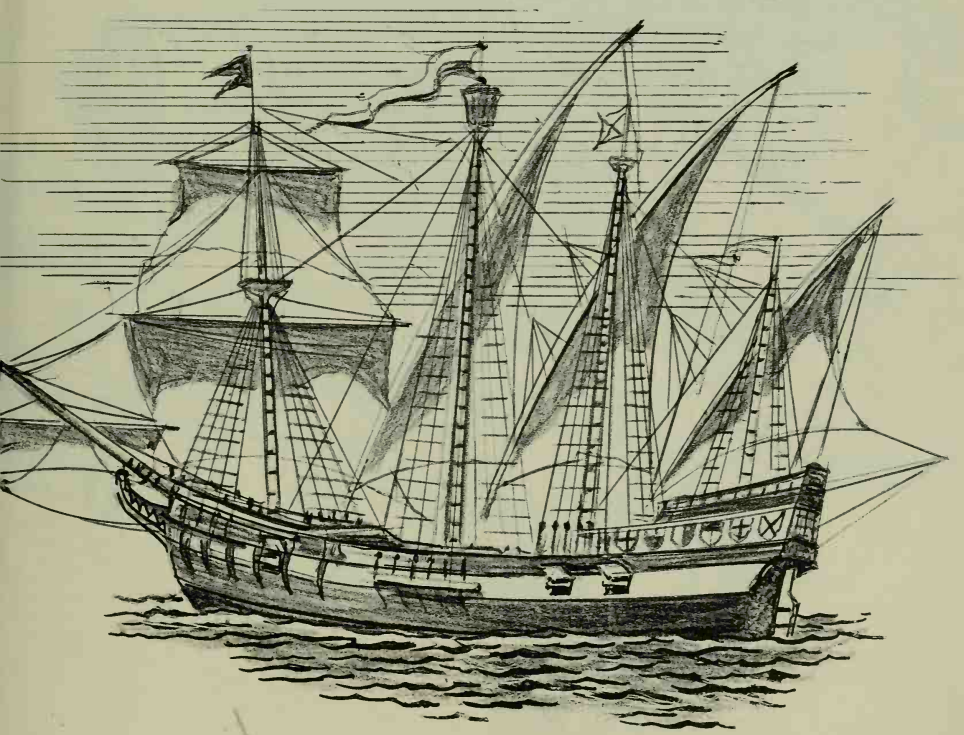
the forerunner of many others, down the west coast of Africa in 1415. Within a hundred years his captains had set up *padroes,* stone pillars on which the Portuguese arms were carved, along the coasts of Africa, Asia, the East Indies, and the Spice Islands. They built forts and established rich trading posts under the protection of their warships. Broadsides thundered from the Portuguese ships to bombard Calicut and Malacca, and finally the Portuguese were undisputed masters of the East.

Meanwhile, following the course set by Christopher

Columbus, Spain sent galleons bristling with cannon and crammed with arquebusiers to occupy the West Indies, Mexico, and Peru. The conquistadors enslaved the Indians who labored in the mines to produce the fabulous treasures of gold, silver, and precious stones sent back to Seville. It was because they had firearms and horses, which the natives held in fear and awe, that these few white adventurers conquered such vast numbers of native Indians.

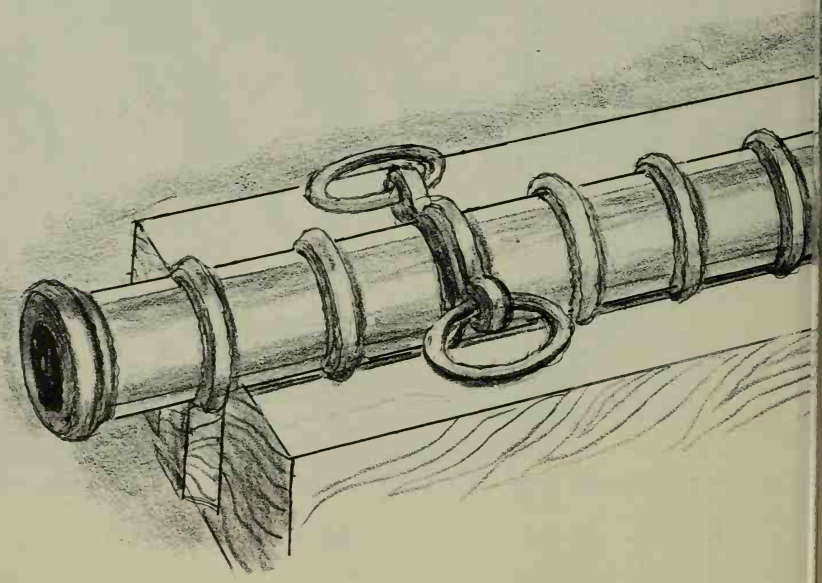
The Spanish and Portuguese, motivated by Gospel, Gold, and Glory, began to achieve a monopoly in the

PORTUGUESE CARAVEL



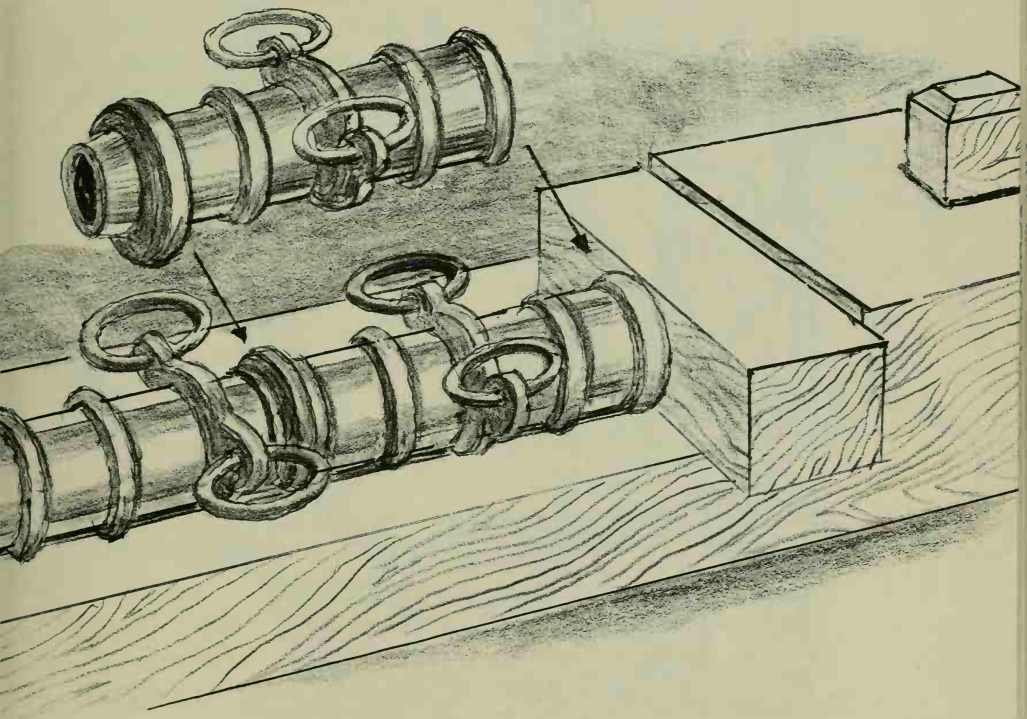
New World, and in 1493 the Pope established a Line of Demarcation so that they would not fight among themselves for the new possessions. A year later the Treaty of Tordesillas amended the line; it divided the New World in half, assigning most of the eastern colonies to Portugal and those in the west to Spain. But the other maritime nations—England, France, and Holland—wanted slices of the pie and the cannon of their fleets began challenging the Spanish and Portuguese empires.

Armed ships also played an important role in naval battles in European waters, such as the battle of Lepanto, fought off the Greek coast in October 1571 between a fleet of nearly two hundred Christian galleys and a large Turkish fleet. The Turks were decisively defeated, suffering great damage and disorganization from the guns of a squadron of Venetian galleasses, a larger, more heavily armed type of galley, and losing more than a



hundred of their ships. Had the Turks won they could have gained control of the entire Mediterranean, captured Venice, cut off Spain from the Austrian Empire, and perhaps put all of Europe under Turkish domination. Their defeat discouraged the Turks from ever again attempting to conquer Europe.

The English had early recognized the immense possibilities of the cannon aboard ship, and, under the direc-



FIFTEENTH-CENTURY BREECH-LOADING CANNON

tion of Sir John Hawkins, comptroller of the navy, their shipwrights in the 1570's began redesigning their fleet to make the fullest use of guns. As the range of cannon in-

THE *Great Harry*

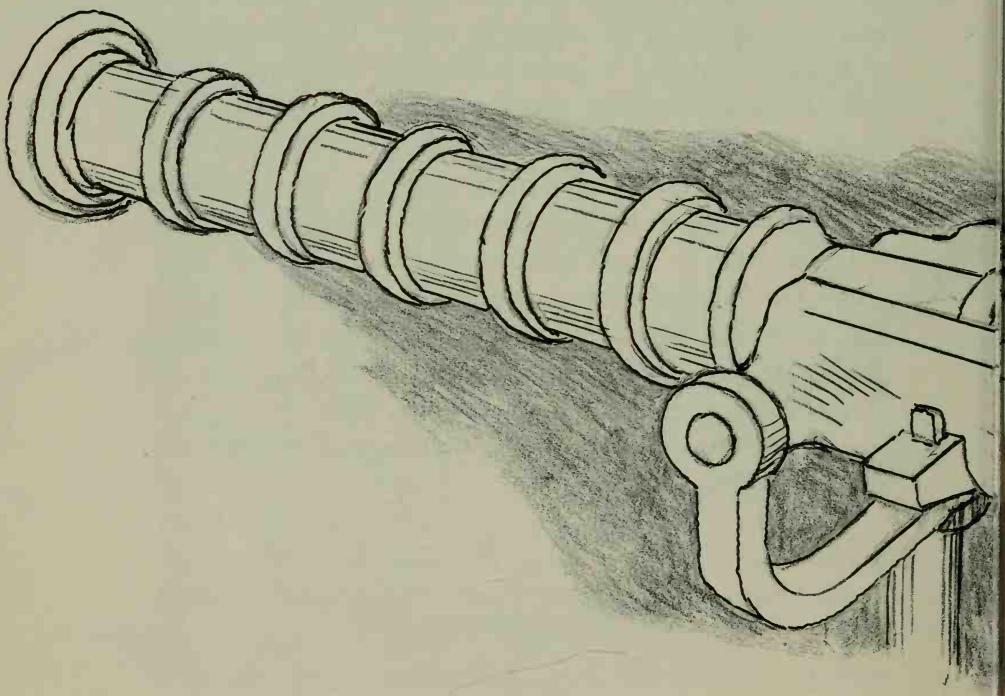
creased and ships battered at each other from a distance, there was less need for castles to help repel boarders. Flush decks also made it possible to mount more guns, but the increased weight of the heavier guns that delivered larger broadsides presented another problem: ships were so top-heavy that they rolled heavily during a storm and were likely to capsize. To correct this the shipwrights gave the hulls deeper draft and built the sides of the large three-deckers with a pronounced tumble-home—that is, the sides were curved inward from the waterline to the rail so that the topmost tier of guns was nearer midships than the lower tiers.

We now come to an historically crucial battle which was decided largely by superior gunnery. In 1588 Philip II of Spain dispatched a great armada of 130 ships, about half of them transports and store ships, under the command of the Duke of Medina Sidonia, carrying more than thirty thousand men, including an army of veteran Spanish troops, toward the English Channel. When they arrived, the duke was to unite his forces with a Spanish army under the Duke of Parma, waiting in Flanders. The fleet was to secure Parma's crossing and the invasion of England. The success of this bold plan would have put all of western Europe and England under Spanish rule and completely changed the destiny not only of Europe but also of North America.

When the armada appeared in the channel on July 19, headed for Plymouth where the English fleet had collected under the admiral-in-chief, Charles Lord Howard, and Vice Admiral Sir Francis Drake, the English ships were just able to get to sea and escape being blockaded before the duke anchored off Plymouth on the twentieth.

The night had nearly fallen when the Spaniards saw the English lying to leeward. Rather than pass the English by and find them windward in the morning the Spaniards dropped anchor awaiting a dawn attack. But with the help of a stiff wind the queen's ships gained the windward during the night and the next morning bore down on the surprised enemy.

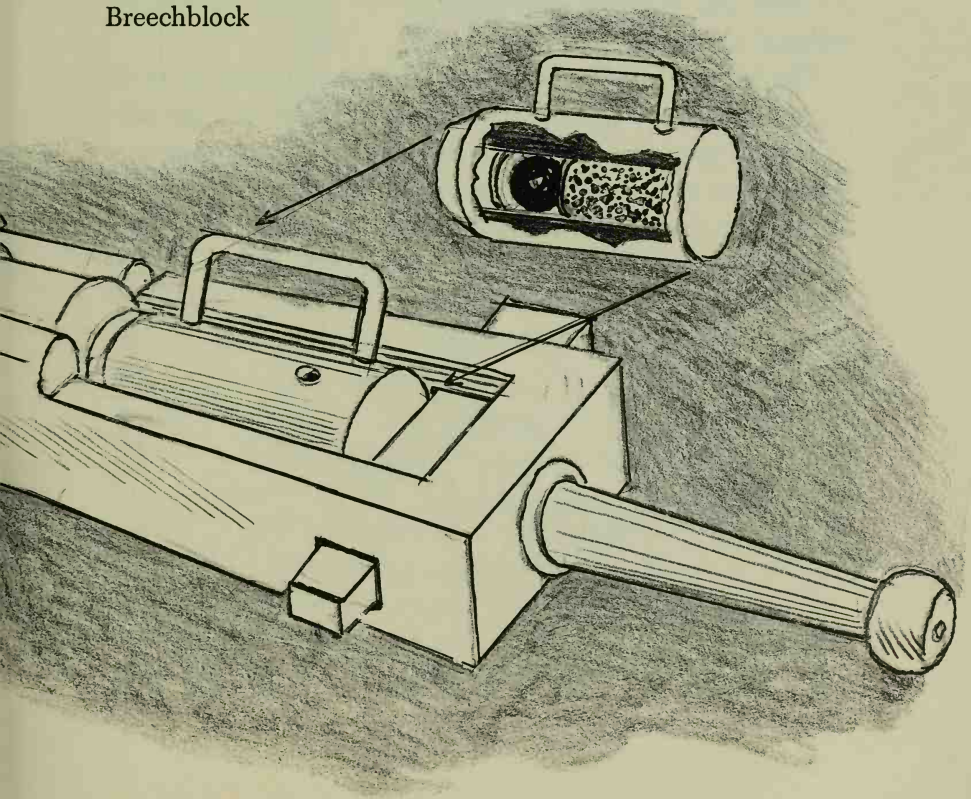
Then followed a demonstration of the new naval tactics made possible by English guns and training. Instead of each ship making contact with one enemy vessel, grappling and boarding as was customary, and giving the



FIFTEENTH-CENTURY BREECH-LOADING SWIVEL GUN

Spaniards with their greater manpower an advantage, Drake's fleet formed a line of battle. Sailing parallel to the duke's rear, the English bore down on the Spaniards and poured broadsides into them, raking the duke's ships. Then the column came about and fired its opposite broadsides, slaughtering hundreds of the enemy.

For more than ten days the English ships kept to the windward, engaging in numerous actions. On the night of the twenty-eighth they attacked the anchored Spanish fleet with fireships, and to escape this dreaded form of attack the Spanish cut their cables and put to sea in con-



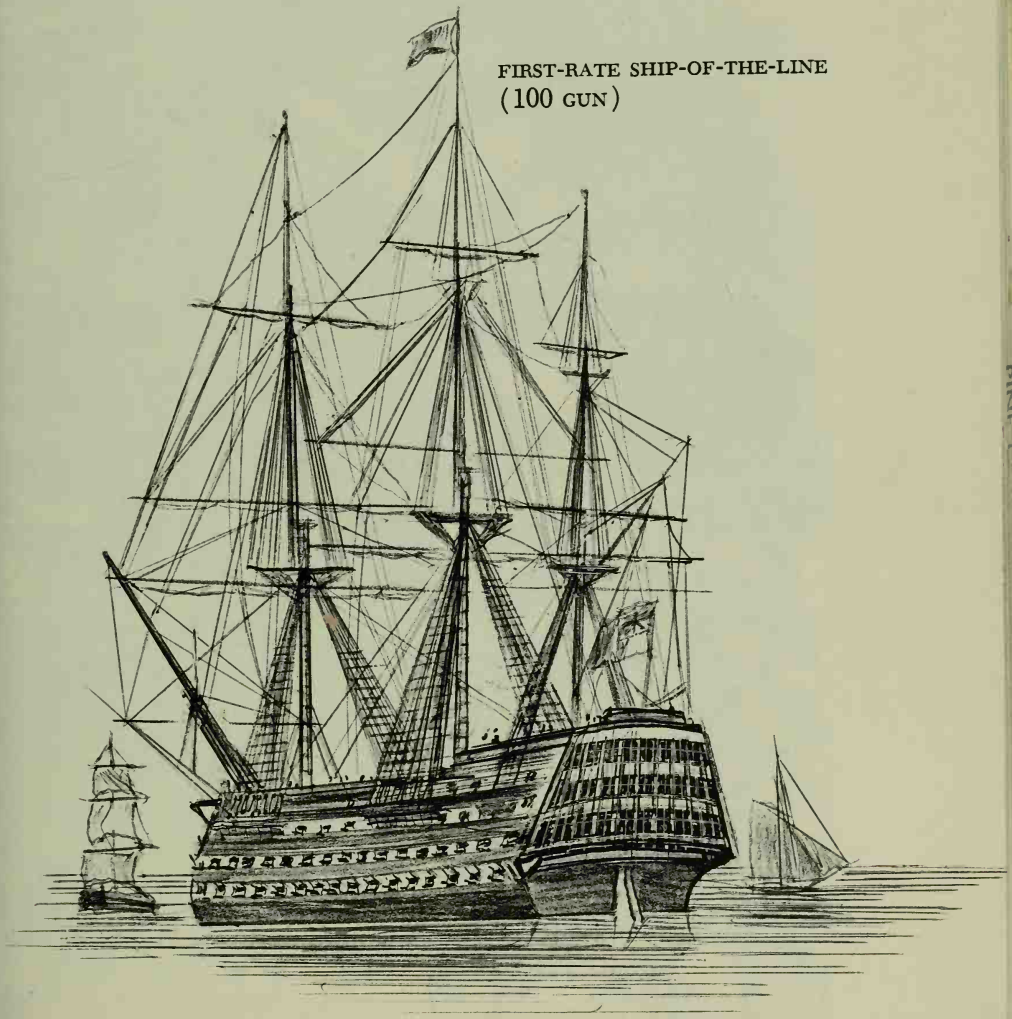
fusion. The fiercest engagement took place on the twenty-ninth, when the English ships closed their range and, their guns finally truly effective, battered the Spanish hulls. The next day, when the English had just about run out of ammunition and were expecting to see the Spanish driven onto a lee shore, a sudden shift in the wind enabled them to claw off the shoal and flee northward. They rounded Scotland and lost many of their ships on the west coast of Ireland; when they swam to shore most of the crews were put to death.

A little more than half the once-proud armada limped into Santander, having lost fifty-one ships and twenty-thousand men. Their defeat not only saved England from invasion but was the beginning of the decline of Spain's colonial empire.

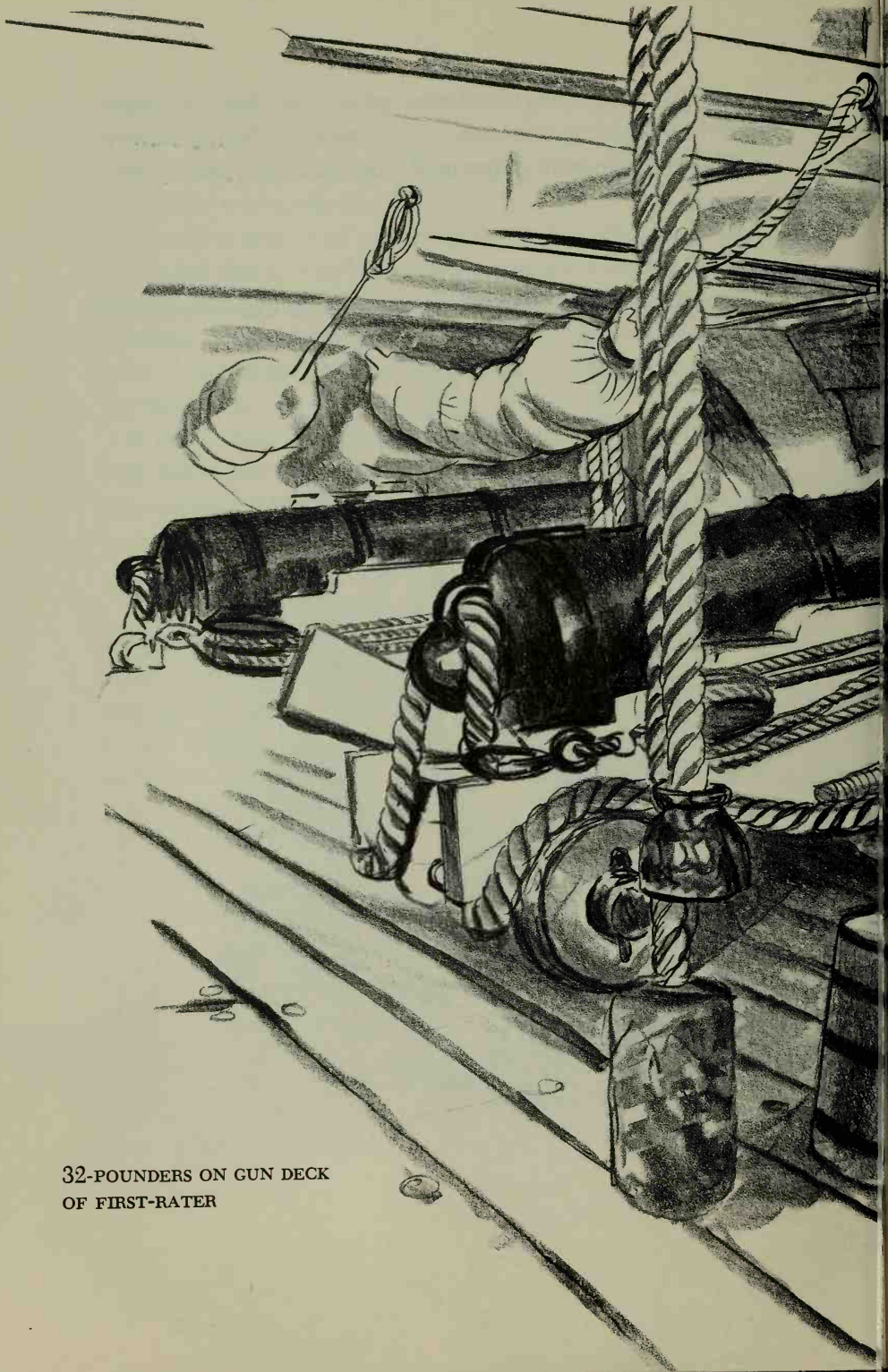
The seventeenth and early eighteenth centuries marked the separation of the merchant ship from vessels specifically designed as warships. Previously a merchantman was turned into a naval vessel simply by cutting gunports in her sides and mounting a row of cannon. Now the tactics of a naval battle called for forming a fleet into a line of battle as Drake had done, each ship following closely behind the one ahead until the line was abreast of the enemy. Then each ship sent its broadsides as quickly as possible into the opposite vessel, although an entire port or starboard broadside was not fired simultaneously, as the concussion and recoil of all the guns going off at once would have seriously weakened the ship's frames; instead, they were fired rapidly in succession.

When a ship had to drop out of the line because her hull or rigging was damaged, the enemy tried to cross her bow or stern and rake her, sending a broadside plunging

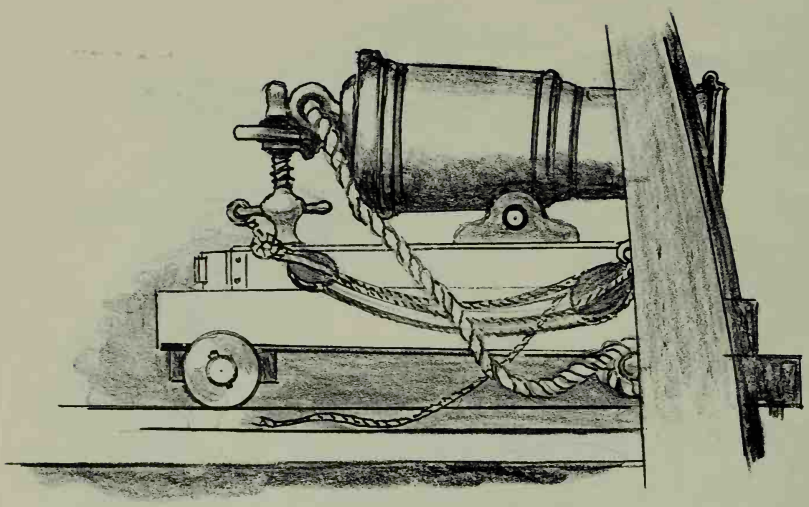
along the length of her decks, which smashed her guns and killed the gun crews. Since smaller, lightly armed converted merchant ships could not stand up to the fire-



FIRST-RATE SHIP-OF-THE-LINE
(100 GUN)



32-POUNDERS ON GUN DECK
OF FIRST-RATER



CARRONADE

power of the big ships-of-the-line, naval designers began building larger vessels specifically for fighting, which were rated by the number of guns they carried. A first-rater carried a hundred or more guns on three decks, a second-rater from eighty to a hundred, and a third-rater, seventy-four on two decks. The latter was probably the most useful of the three, as it was easier to handle than the ponderous first- and second-raters and could sometimes almost match their firepower when rough weather forced them to keep their lower-deck gunports closed for fear of being swamped.

A first-rater was, on the average, 190 feet long on the gundeck, with a 52-foot beam and a draft of 21 feet, and it displaced 3500 tons and carried a crew of 900 men. Her lower gundeck carried 32-pounders, on her middle deck

were 24-pounders, and on the upper deck 18-pounders, with some 12-pounders on the forecastle and quarterdeck. She was a huge, unwieldy, slow-sailing craft but she could deliver the most powerful punch at sea during the age of sail.

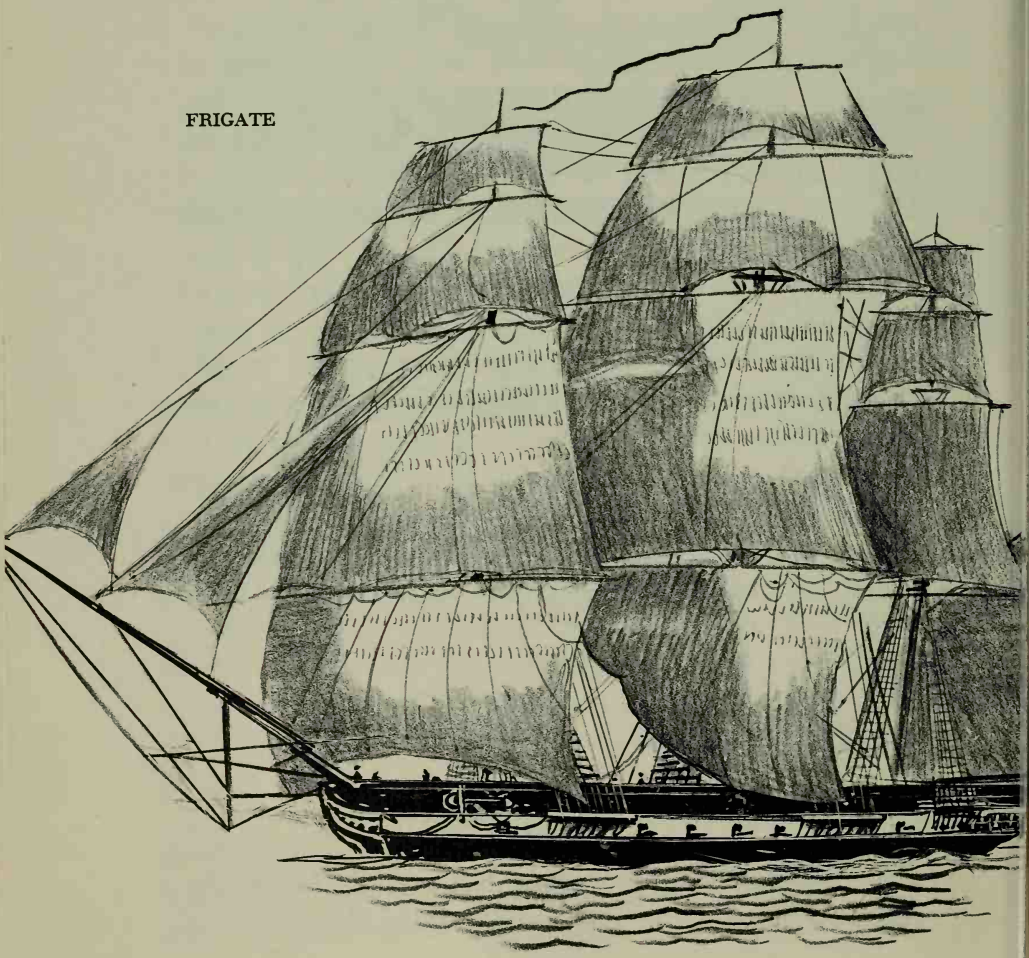
Below the ships-of-the-line were the ships carrying sixty-four, sixty, and fifty guns, which were useful for attacking enemy cruisers and sloops, raiding, and supporting land operations. They were often the flagships of cruiser squadrons. Extremely important were the frigates, swift cruisers used for scouting. They were all that the sailing admirals had to carry on the functions performed in a modern navy by the radio, radar, and scouting planes.

Frigates and corvettes mounted 24- and 18-pounders. Eventually it was found that, with improved powder and better gun handling, the naval-gun barrel could be shortened without losing much range. Here are the lengths of eighteenth-century naval guns before and after the change:

Weight of Ball (pounds)	Old Length (feet)	New Length (feet)
3	4½	3½
6	7	4⅓
9	7	5
12	9	5½
18	9	6⅓
24	9	7
32	9½	7½
42	10	8⅓
48	–	8½

By the eighteenth century, guns were no longer described by the size of their bores but by the weight of

their projectiles. Their sizes had also become standardized; those of English naval guns had been reduced to nine sizes, with the two largest, the 42- and 48-pounders, generally used only as bow chasers, where range was important. The heaviest gun in the broadside of the



FRIGATE

eighteenth-century first-rater was the 32-pounder, which was mounted on the lower deck where it could not be used in battle when rough weather made it necessary to close the lower ports to prevent swamping.

After the American Revolution, in which the tiny American navy was almost obliterated, the government was much too poor to build ships-of-the-line, so it was decided to concentrate on frigates, which could outrun any 74- or 90-pounder but were more powerful than foreign frigates. For example the *Constitution* rated as a 44, was 175 feet long, and had a beam of 44 feet. She was armed with some thirty 24-pound long guns on her gundeck and some twenty 32-pound *carronades* on her spardeck. A carronade was a lighter, shorter cannon that left room for six more guns than the ship was rated for. American frigates were widely used against the Barbary pirates in the Mediterranean and in the War of 1812.

Below the frigates were the sloops of war—three-masted ship-rigged vessels—and brigs and schooners, with from ten to twenty guns. which were used for carrying dispatches and taking prizes.

The early eighteenth century saw constant warfare in the West Indies between the British, the French, and the Spanish for possession of the rich sugar-growing islands; they changed hands constantly as great sea battles gave first one fleet and then the other a victory.

At this time the French navy had the fastest and best-designed ships and the best-trained crews, but by the 1730's the British, because of innovations and improvements in training, were beginning to catch up. The English realized the value of delivering a smashing weight of metal upon the enemy *first,* so they reduced the num-

ber of short-range, light guns and mounted more culverins, which could throw a 17-pound ball a mile and a quarter.

Gunners in the French navy were taught to fire on the upward roll of their ships so that their missiles would damage the masts and rigging of the enemy, while the English fired on the downward roll to dismount enemy guns, kill their crews, and hole the ship at the waterline. Although it was true that a dismasted sailing ship became a helpless hulk, the English captain tried to batter the enemy into submission before his own ship's rigging was destroyed. Damaged rigging could be repaired more easily than a smashed hull.

The British also made improvements in shipbuilding which, for a time, made their ships faster than the French ones. Wooden sailing ships collected marine growth, barnacles, and teredos or ship-worms on their bottoms, which slowed them down, and the shipworms bored into the planking until the hull eventually became so rotten it fell apart. After trying tar, tallow, and many other substances to discourage these pests and avoid having to careen and scrape the hulls at frequent intervals, the British navy tried covering ships' bottoms with thin lead sheets, but they proved to be too heavy. When British mills learned how to roll thin copper sheets, they solved the problem. The French, for some reason, delayed coppering their ships, and until they did the barnacle-free British vessels consistently outsailed them after a few weeks at sea.

But it was in gunnery and gun improvements that the British made their greatest stride. General Robert Melville invented the carronade, so called from the Carron Gun Works in Scotland where it was made in 1759, and

the navy adopted it in 1779. Because it was lighter in weight and shorter in the barrel than the usual cannon, it could be served by a smaller gun crew. It would throw a ball of up to sixty-eight pounds for a short distance because the powder charge had to be kept small in order not to burst the light barrel. The lower velocity proved to be an advantage because the smaller, high-speed ball from a long gun made a small, neat hole in a ship's side that could easily be plugged by the carpenter, while the carronade's ball tore and splintered huge gaps in the planking.

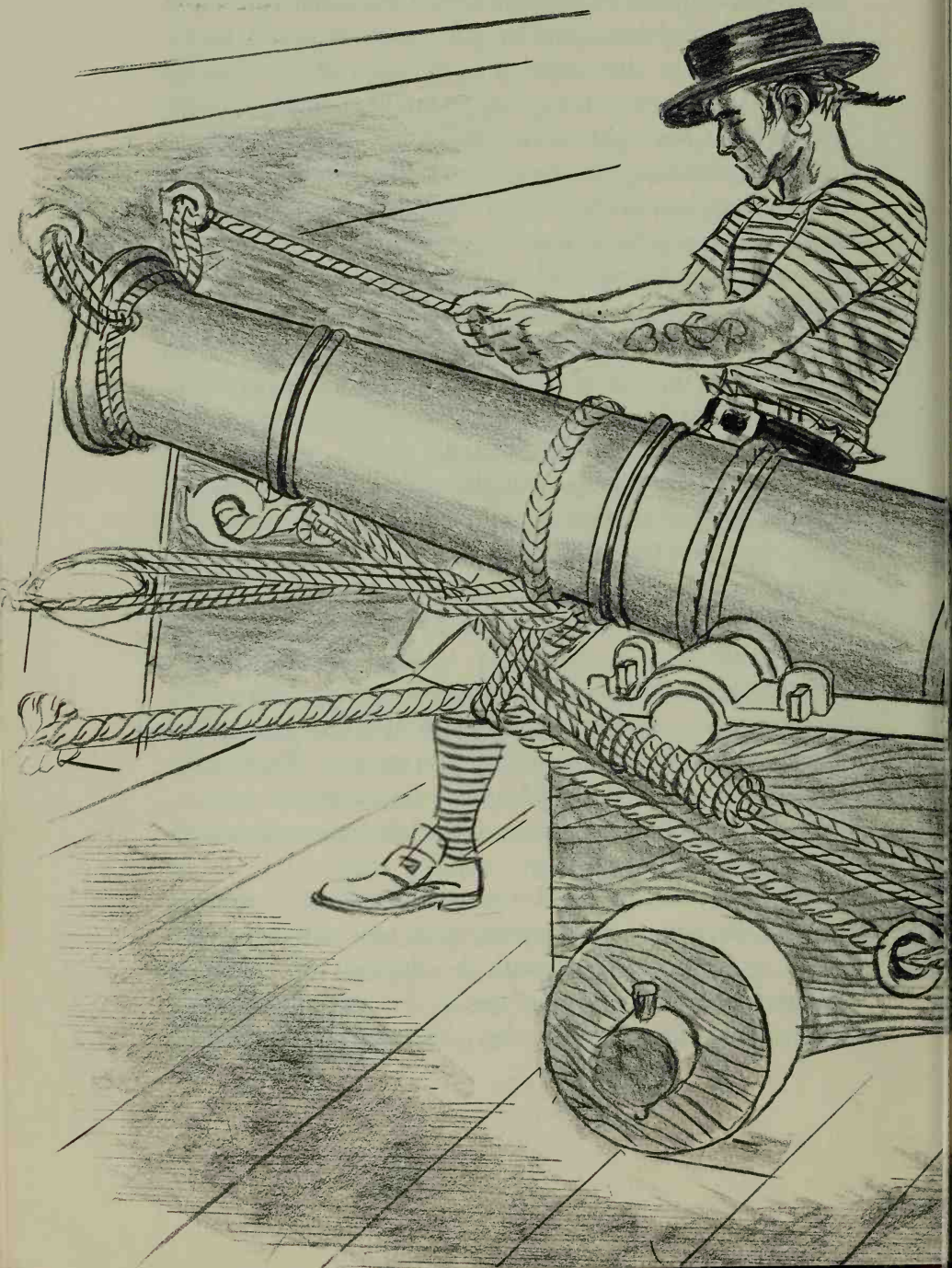
For a time the carronades gave the British a great advantage over the French, but later, after the War of 1812, naval captains learned to keep out of their range and these guns were finally abandoned.

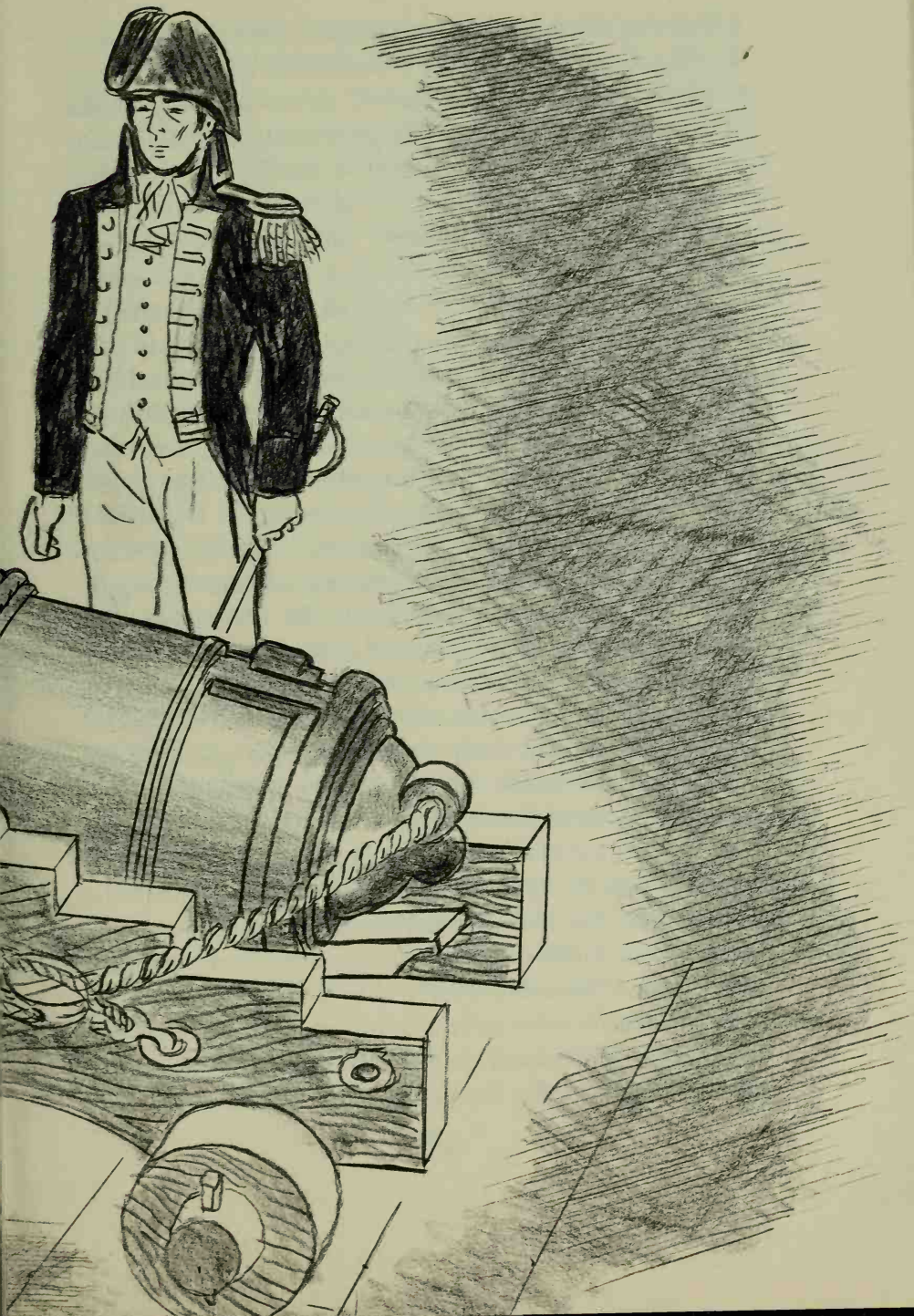
About 1780 Sir Charles Douglas, Admiral Rodney's fleet captain, suggested several improvements to increase the range and rapidity of broadside fire. Until then a gun could only be aimed through the port at right angles to the ship's side and its target had to be directly opposite to get in range.

Extra tackle was added so the gun crew could swing the gun carriage to the left or right and extend the radius of effective aiming four points to either side. This made it possible for a fast British gun crew to get in two or three shots at a passing enemy ship while the enemy could fire only one.

After the recoil of the discharge threw a gun carriage back to the end of the breeching, it took some time to nudge it forward again with handspikes. Sir Charles designed an arrangement of inclined planes and heavy springs and counterweights that absorbed part of the re-

24-POUNDER MOUNTED ON CARRIAGE WITH BREECHING





coil so that the gun could be brought to bear much sooner. The time consumed between broadsides by sponging out the gun barrel after each shot to douse any stray sparks that might set off the next charge prematurely, and cleaning out unburned cartridge paper from the breech with a worming tool, a pole with a sort of corkscrew at the end, was much reduced. Sir Charles found that by using silk cartridges with flannel bottoms and wet wads the sponging and worming operation could almost be eliminated.

To prepare a gun for firing, the gun captain had to pour priming powder out of his powder horn into the touchhole and trail a thread of powder back from the vent. Then he touched the linstock, which held the glowing slow match to the trail of powder, and leaped back to safety before the charge exploded and the gun recoiled.

Captain Douglas gave his gunners a supply of perforated goose quills filled with priming powder. The gunner simply thrust one of these down the vent, applied his match to the top of the quill, and stepped back. Later, the flintlock type of ignition used in muskets was mounted on the cannon barrel. It was triggered by a lanyard pulled by the gun captain from well behind the gun and the dangerous slow match was completely eliminated.

At the Battle of the Saints, off Guadaloupe in 1782, the French fleet suffered heavily from this improved British gunnery and its officers were puzzled about how the enemy could fire their broadsides so often and so quickly. The British retained the advantage of superior gunnery and better seamanship over the French and Spanish all through the Napoleonic wars, partly because Napoleon never really understood naval warfare, underrating its importance and starving the navy in favor of the army.

The British fleet, commanded by Lord Nelson, was able to annihilate the French fleet at the Battle of the Nile in 1798, cutting off the French army in Egypt. Nelson's victory over the combined French and Spanish fleets at Trafalgar in October 1805 confirmed the British navy's rule of the ocean, ruined French overseas commerce, and helped speed Napoleon's downfall.

Warships of the sort used by Lord Nelson to defeat the French in the battle of the Nile at the close of the eighteenth century were still the last word in fighting machines for more than a quarter of a century. Sail was still the motive power and guns changed little.

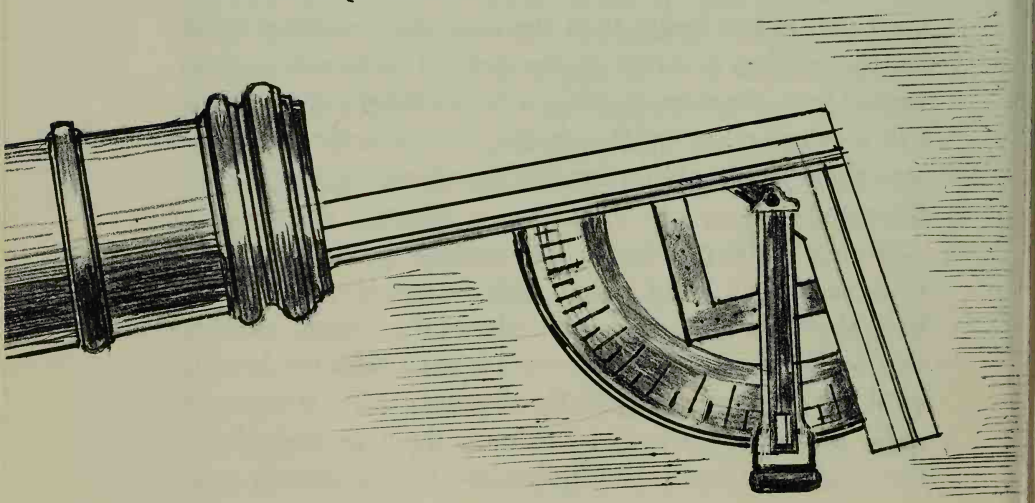
Until well into the nineteenth century, naval gun carriages were built of elm or oak. The cheeks or sides of a 24-pounder were made of several 6-inch planks carefully mortised together. The first carriages had only two wheels at the front, with the trail resting on the deck, but by the early eighteenth century they had four wheels or trucks of wood or iron to make handling easier. The front wheels were two inches larger than the rear ones to compensate for the camber or curve of the deck. The trunnions projecting from the sides of the gun barrel fitted into cutaway half mortises on top of the cheeks, with iron straps bolted over them to keep the trunnions from jumping out during the recoil.

Normally the gun lay in the carriage pointed upward to its maximum firing range, with its muzzle lashed to a bolt above the gunport; to reduce the range, wedge-shaped blocks called quoins were driven under the breech until the gun was sufficiently depressed. To traverse a naval gun, the carriage had to be nudged to one side or the other with heavy handspikes. By the nineteenth cen-

tury, carriages were being made of iron because gun barrels were becoming tremendously heavy. Their rear wheels were designed to run on quadrant-shaped rails spiked to the deck, which made traversing comparatively easy. When a muzzle-loading cannon barrel was to be depressed for extremely short range so that the barrel pointed downward, the loader had first to ram a wad or grommet down the barrel to prevent the ball from rolling out of the muzzle.

Handling a land-based gun carriage was one thing, but the same job on the gundeck of a rolling, pitching ship-of-the-line or frigate was something very different. The fear that a gun might break loose during a storm constantly haunted the captain of a sailing man-of-war, for such a cannon could kill or maim crewmen, destroy bulwarks, crack masts, smash other guns, and sometimes even sink the ship. To prevent this and yet be able to run

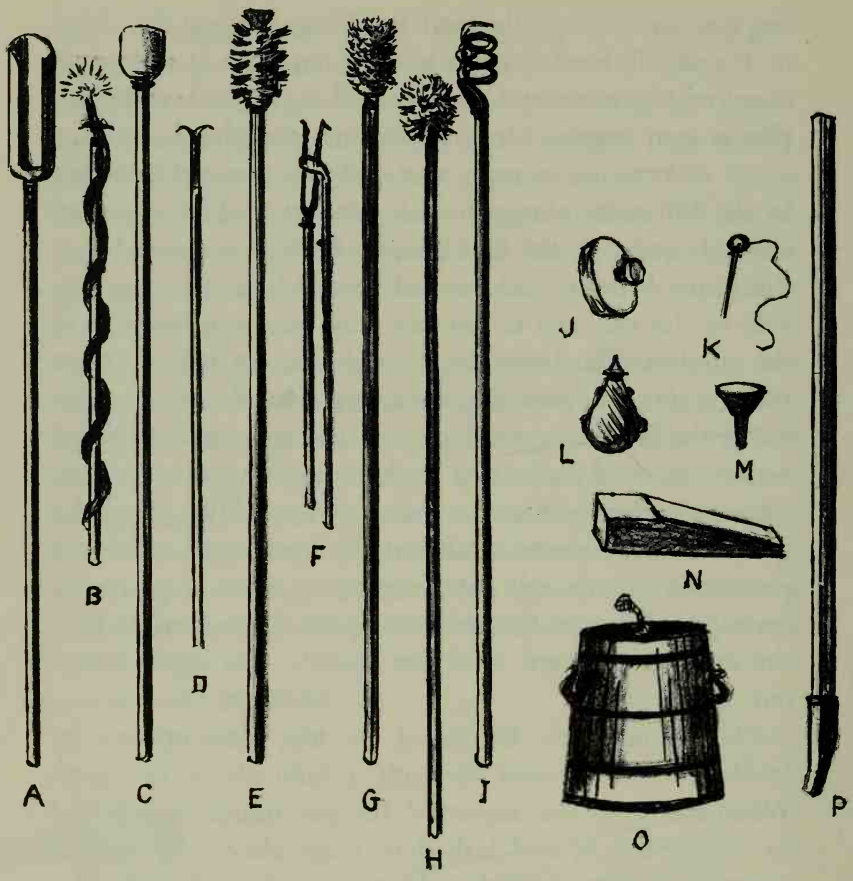
CANNONEER'S QUADRANT



the gun out through the port for firing, take up the shock of the recoil, haul it back to lead, and run it out again required ingenious and complicated tackle and well-disciplined gun crews. Most important was the breeching, made of very heavy rope; one end was secured to a ring in the bulwarks alongside the gunport and then passed through a ring in the cheek and a hole in the cascabel in the gun's breech, and carried forward on the opposite side of the carriage to another ring on the other side of the gunport. This breeching brought the carriage up short when it was sent plunging backward from the recoil. After firing, the breeching was loosened and the gun was hauled farther inboard by a trail tackle running from the carriage to a ring bolt set in the deck amidships. Then the gunners were able to swab out the barrel and reload. A pair of two-block side tackles running from rings in the carriage to rings in the bulwark enabled the crew to haul the carriage forward until the muzzle was again thrust out of the port.

The gunport lids, hinged at the top, were opened by tackle carried inboard through a hole above the port. When no enemy was expected, the gun muzzle was raised to its full height and lashed to rings above the port to prevent the gun from knocking open the lid when the ship rolled.

Sights like those used on muskets were not of much use on cannon so the gunner simply squinted along the top of the barrel. Still, he had some help. The gunner's quadrant, a wooden square with one longer arm and a quarter circle or quadrant marked in ten equal degrees, connected the two arms. From the joint of the square a metal plumb bob hung just above the quadrant. The gun



CANNONEER'S TOOLS

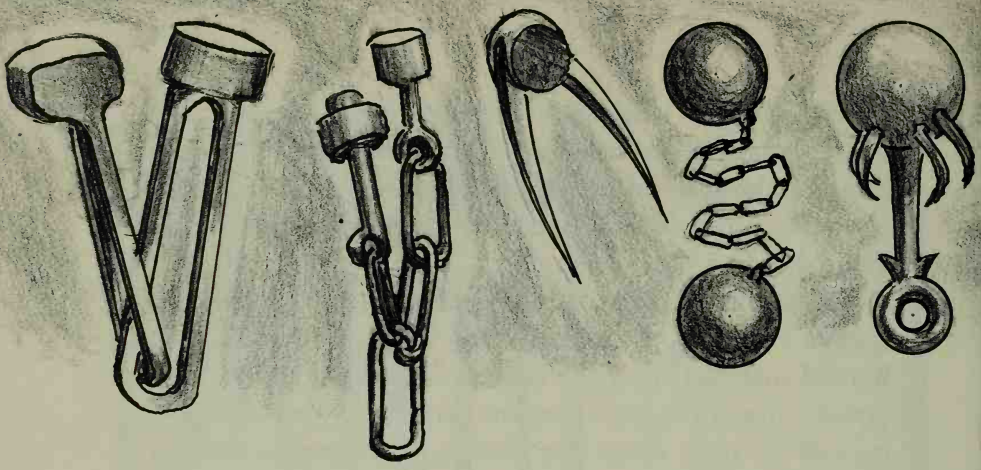
A	Ladle	J	Tampion
B	Linstock	K	Touchhole Pricker
C	Rammer	L	Priming Powder Flask
D,F	Hooks for Withdrawing Cannonballs	M	Funnel for Priming
		N	Chocks
E	Brush	O	Cartridge Tub
G-H	Mops	P	Handspike
I	Worm		

captain slid the longer arm into the gun and noted the degree from the vertical at which the bob hung. This gave him the elevation of his gun and permitted him to make corrections, provided the ship was not rolling, if the previous shot had been long or short.

The gunner's tools consisted of a water bucket and sponge to swab out the bore; the worm to drag out unburned material from the breech; a ladle to thrust loose powder down the bore (before cartridges were used); a rammer to push down the charge; a scraper to clean a fouled bore; a cat or searcher, which had radiating arms, to search for defects or cracks in the bore; and a gunner's pick, a sort of awl to keep the vent clear and to prick the cloth of the cartridge. Sometimes a combination swab and rammer joined by a heavy rope handle, which was flexible but fairly stiff, was used when the gun was not drawn back enough to use a pole. A tampion, a wooden plug with a handle, was jammed into the gun muzzle to keep out rust when the gun was not being used, and a wooden cartridge box with a close-fitting lid kept the cartridge dry and safe from sparks. Because cannon balls were often not perfectly spherical, a brass sizing ring the exact size of the gun's bore was kept handy, through which any ball of doubtful shape could be passed to make sure it wouldn't get jammed in the bore.

Several metal-tipped handspikes were needed to nudge the carriage into position and assorted quoins were needed for elevation. A tub of slow match stood nearby, along with a linstock, whose spring arm held a length of slow match. There was also a flask of priming powder or a box of quills, before the flintlock came into use.

The design and manufacture of cannon had changed very little for centuries. Nelson won his resounding vic-



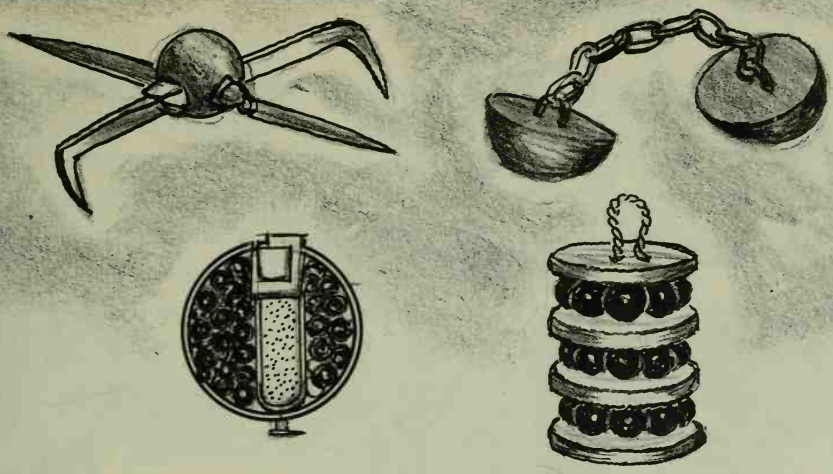
BAR SHOT CHAIN SHOT RIGGING CUTTERS

CANNON MISSILES

tories with guns not very different from those that defeated the Spanish Armada two centuries before, and the method of making a gun barrel was still the same. The cast-iron smoothbore muzzle-loading gun that fired only a round solid ball or such variations as grapeshot, chain shot, or canister still represented the best in artillery. The explosive shell had not yet appeared, except for crude hollow shells filled with musketballs and exploded by a trailing wick, and these were impossible to time accurately. The carronade, the only new gun since Henry VIII, was given up after the War of 1812.

At last, toward the middle of the nineteenth century, some improvements began to appear, hastened somewhat by other naval developments. A new invention, the steam engine, increased the maneuverability of ships, but the deck space used by its paddle wheels made long rows of guns along the ship's sides impractical.

Since a steamer had less space for guns than a three-



CANISTER GRAPE SHOT

CANNON MISSILES

decker, the new designs called for fewer but bigger guns whose barrels had to bear heavier stresses. Builders began to replace wrought iron with cast iron, and later steel superseded iron. The barrels of cannon began to receive rifling, which had for some time been used in small arms. The round, badly fitting cannonball was replaced by cylindrical projectiles that fitted the bore better and gripped the rifling. Finally, the explosive projectile, which was filled with powder and set off by a detonator on contact, also increased the destructiveness of naval artillery.

In the 1850's Major Bomford of the U.S. Army invented the *Columbiad,* a gun with a barrel that had a greatly reinforced breech for heavier charges and whose weight was a compromise between the obsolete carronade and the long gun.

John Ericsson, inventor of the famous *Monitor,* in 1840 designed a twelve-inch gun made of tough wrought iron instead of the customary brittle cast iron, but an accident

DAHLGREN CANNON

to another wrought-iron gun not built by him discredited the metal for naval use for years.

Next, Army Captain Rodman invented a new casting procedure. He cast his gun around a sand core and cooled the inside by wetting the core so that the inside metal cooled first and the outside metal shrank slowly around the center, making it more durable. With this barrel and

slow-burning caked powder, the gun could fire much heavier charges. The Parrott rifle, an adaptation of the Rodman, but with a heavy wrought-iron jacket shrunk over the breech of the cast-iron barrel, was widely used by the Union during the Civil War, although it sometimes burst at the unreinforced muzzle.

Also in the 1850's Commander John A. Dahlgren of the U.S. Navy built a smoothbore cannon radically different in appearance from all previous guns. He studied the curve of pressures exerted on a barrel and found where the greatest strains occurred. Then he built a bottle-shaped gun barrel (familiarly called "the soda water bottle") whose greatly thickened breech tapered off considerably toward the muzzle. This shape enabled it to take a much heavier powder charge. The Dahlgren was used extensively during the Civil War and for some time after. In 1862, for instance, there were Dahlgrens on board both the *Monitor* and *Merrimac* when those ironclads fought their famed duel and made the importance of armor, steampower, and gun turrets obvious to the world.

Eventually the big Dahlgren was superseded by a built-up type of barrel in which several casings of wrought iron and, later, steel covered an inner tube of cast or wrought iron; they were applied when red-hot and were shrunk tightly onto the inner core when they cooled.

About 1855 a British designer, Sir William Armstrong, made a further improvement by twisting a bar around a core or winding the core with wire and welding it so that the strain was taken along the length of the barrel instead of across its width. In 1851, Germany's Alfred Krupp produced the first successful all-steel gun whose superior strength eventually made all other types obsolescent.

Just about mid-century the age-old problem of the leaking breechblock was also solved. It had been known for a long time that a breechblock that screwed into the barrel was the only satisfactory way of obtaining a gas-tight fit, but when a cannon fired, the heat of the explosion expanded the metal of any screw and prevented opening the block to reload until it had cooled. About 1850 a block was designed that had an interrupted screw thread so that it could be opened or sealed with a simple quarter turn, thus avoiding the expansion difficulty.

The breech-loading gun made another development possible—the revolving gun turrent. It was invented in 1843 and permitted a gun in a center-line turret to traverse a 180-degree radius, but it was not practical because there was not room enough in a turret to retract a gun far enough to load it at the muzzle. The new breechblock solved that, made broadside-mounted muzzle-loading smoothbores obsolete, and ushered in a class of warships with large, rifled, turret-mounted guns. Of course, it took a few years, as usual, for the military to adopt such a radical improvement. All through the Civil War and for two decades afterward American naval ordnance officers continued to prefer muzzle-loading smoothbore cannon over breech-loading rifled guns because their large-caliber solid balls backed by heavy explosive charges penetrated armor better than the smaller and weaker rifled guns of that time.

By the end of the nineteenth century the modern cannon was beginning to take form. In addition to the new breechblock with its interrupted screw thread, shells were developed with copper rotating bands that gripped the rifling firmly and increased the range and accuracy of

projectiles. Recoil mechanisms, in which plungers operating under pressure in oil-filled cylinders bolted to the gun barrel, dampened the shock of the recoil so that the entire piece no longer plunged backward.

After the Civil War the American navy was permitted to deteriorate so badly that by the 1880's it was quite out of date; even the navies of some of the smallest South American republics had better ships and guns. Not until the last years of the nineteenth century was a modernization program begun and a modern new navy put into being—just in time to destroy the Spanish fleets at Manila and Cuba. Then, for the first time, the United States acquired responsibilities beyond American shores and became a colonial power. Hawaii, the Philippines, and Guam in the Pacific and Cuba and Puerto Rico in the Caribbean made a two-ocean fleet necessary and the Panama Canal a must.

The launching of the British battleship *Dreadnaught* in 1907 revolutionized all the navies of the world. The *Dreadnaught* was the first all-big-gun warship, with 12-inch rifles mounted in revolving center-line turrets backed only by a secondary battery of 6- and 8-inchers and some quick-firing small rifles. Every navy realized the immense superiority of the *Dreadnaught* design and scrapped their own plans. From then until well into World War II they raced to build bigger and more powerful ships. The size of the big guns increased from 12-inchers like the *Dreadnaught*'s to 13-, 14-, and 16-inch, and finally to the 18.1-inch rifles of the Japanese World War II vessel *Yamato,* which fired a 3200-pound projectile, 50 per cent heavier than the 16-inch missiles of the U.S. Navy.

Although World War I introduced a new naval missile—

the submarine-fired torpedo, and the defense against the submarine—the depth bomb, neither was strictly a gun, and the armament of warships remained much the same except for various improvements in aiming and rapidity of fire controlled by electronic fire-control centers. At sea, antiaircraft batteries were already being mounted on ships, although the airplane had not as yet become very effective.

World War II introduced a new weapon that overturned the entire concept of naval warfare—the aircraft carrier and its planes. Battleships could and did bombard targets over the horizon by means of radar, electronic computers, and their own scout planes; and there were still duels between naval ships and between ship and shore installations. But most of the warship's enemies now zeroed in from the clouds or the depths of the sea. The most effective missiles, instead of being fired from a cannon barrel, came from torpedo tubes and bomb bays.

The battleship, no longer queen of battles, had suddenly become practically obsolete, her throne taken over by the aircraft carrier, now the nucleus around which a modern fleet operated. The carrier did not need to mount big guns; her destructive power was delivered by squadrons of bombers and torpedo planes launched from her flight deck. The muzzles of her antiaircraft guns all pointed into the skies, hunting enemy attack planes.

Atomic power brought further radical changes in naval planning, when nuclear power plants in ships incredibly increased their cruising range. In 1960 the nuclear-powered submarine *Triton* circumnavigated the earth without once coming to the surface.

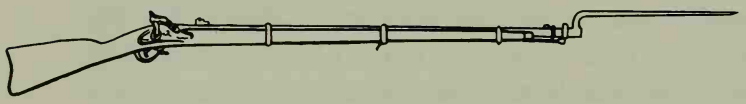
Next the incredibly difficult problem of building sub-

marines that could discharge ballistic missiles from below the surface was solved. The submarine *Polaris* and her sisters can now aim and discharge their missiles while submerged, and the new guided-missile cruisers perform the same task on the surface.

Even with such absolute weapons available, the wars in Korea and Vietnam have constantly demonstrated that the modern military machine must remain flexible. In limited wars every firearm in the military arsenal, short of the nuclear bomb, seems to be needed; the mothballed battleships may even yet be reactivated.

The firearm has changed quite a lot in the 650 years since the first *pot-de-fer* fired its crossbow bolt and the first mortars tossed their stone balls into the air. Today's radar-guided, heat-seeking rockets armed with warheads are only the latest in a continuing search for even more sophisticated weapons. The Chinese used rockets before the discovery of cannon; today, the wheel has come full circle and rockets are a mainstay both as space vehicles and missiles.

Guns: Matchlock to Percussion



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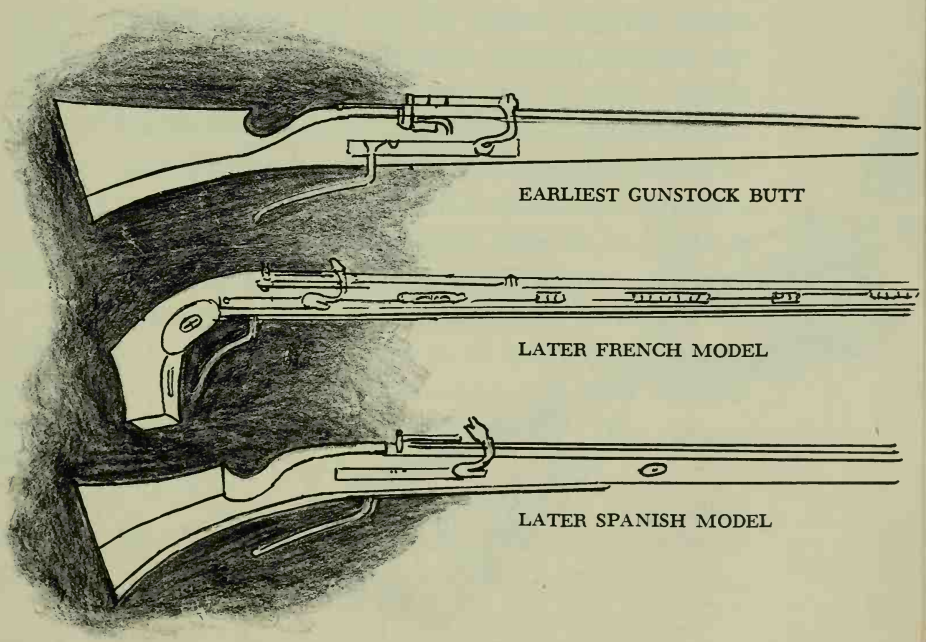
As we have already seen, cannon came before hand guns, but they were awkward and heavy. A type of "hand cannon" that could be carried about by the individual soldiers was developed, the tillers or handles of which later developed into the gunstock. These wooden stocks began to be carved into more convenient shapes. At first they were in line with the barrel and held on top of the shoulder, the gunner's cheek next to the butt. Then the French designed a stock that curved downward and was held against the chest. Finally the Spanish began to build butts more like those of present-day guns, which were to be fired from the shoulder, and by 1600 nearly all gunsmiths adopted this design.

All these various shapes of stocks and the sizes of guns in different countries gave rise to many different names. They were called *hackbuts, arquebuses,* or *harquebuses,* words that derived from the Middle German *Hakebusse* meaning "hook gun," because they had a hook under the barrel just behind the muzzle which the gunner hooked over the top of a wall or fence so that the recoil wouldn't knock him down.

The *caliver* was a light shoulder-fired gun; the *petronel*

was fired with the butt against the chest; and the Spanish *mosquete* (1534), from which the term *musket* derives, was a heavier military weapon requiring the fork rest. Not only were gunstocks designed more conveniently, but barrels were made lighter and longer and the bores smaller for better accuracy; and more practical ways were found to ignite the charge.

The earliest true hand gun was the matchlock, which first appeared about 1450 and remained in use for hundreds of years because it was easy and inexpensive to make. The lock of a gun is any device for igniting the charge, and the prefix match- referred to the slow match used. Originally, as in firing a cannon, the gunner had to blow his match to life and apply it to the touchhole, which meant taking his eye from the target and losing his aim.



The gunner ignited his matchlock by pulling back the lower end of the snake-shaped arm in trigger fashion. This was a great improvement because it enabled the marksman to take his eye off the vent and aim at what he was trying to shoot.

The earliest serpentine matchlocks fell forward. Later they were designed to fall backward to the pan facing the gunner so that he could see whether or not his match was properly lighted. On some matchlocks a covered cylindrical case mounted on the barrel contained a coiled length of match that could be pulled out as the end burned away. This kept it dry and out of the way.

Firing a matchlock was a complicated business. The shooter had to remove the match from the serpentine so that it wouldn't ignite the powder accidentally, and then hold it in his left hand, which also held the barrel during loading. Then the musketeer poured a charge of powder

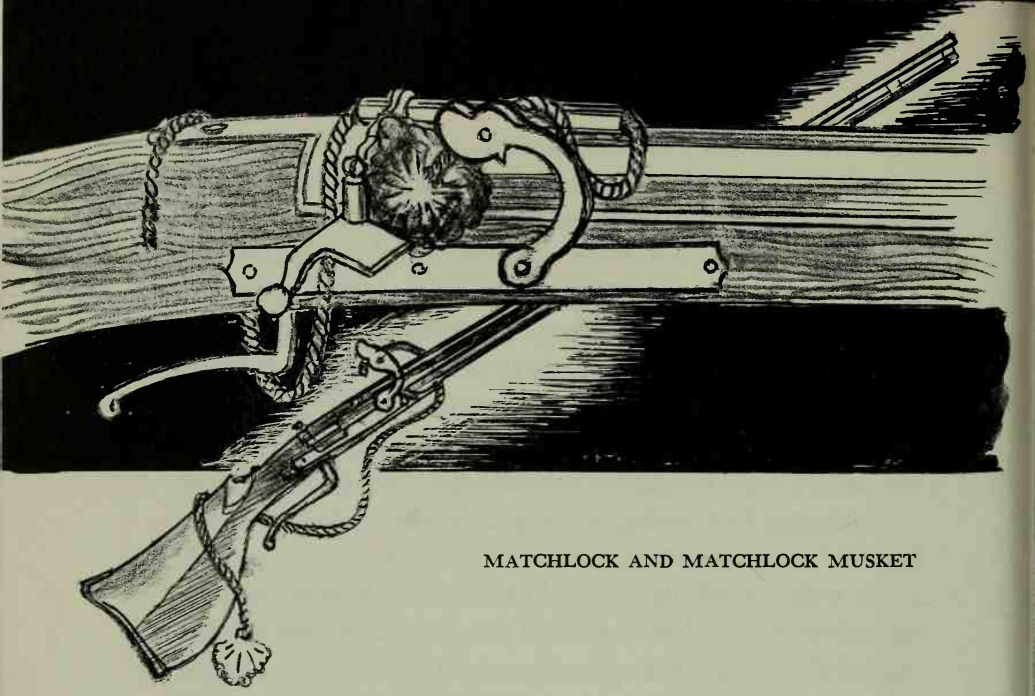
EARLY FOUR-BARRELED HAND CANNON

from his flask into the barrel and added a ball from his pouch or, in battle, from his mouth and a tow or paper wad, which he forced down with the rammer. Next he put priming powder from a second flask into the pan, closed its cover, and blew away any loose powder. He still had a lot to do before firing: he had to clip the match back in the serpentine, adjust it properly so it would hit the pan, blow on its end, and continue to adjust it as it burned (if he had to wait at all for his target to appear) so that it wouldn't burn back too far and go out. What the enemy was doing during this elaborate operation hardly bears imagining.

In spite of all this complication, the matchlock continued to be used in the Far East long after other types superseded it in Europe. It was the standard weapon when the first Portuguese and Spanish explorers introduced it to the Japanese, who, never having seen a firearm before, bought a few and quickly began copying them. The Japanese used them until more modern weapons arrived late in the nineteenth century, and in some remote parts of the world matchlocks can still be found in use.

All matchlock users complained about the awkward burning match that might either be snuffed out by a few passing drops of rain or accidentally explode the powder in the shooter's powder horn. The glowing match also advertised the gunner's position and made it difficult for him either to ambush the enemy or to hide from him. The hunter, too, had his troubles. His quarry, having seen the glow of the match, was long gone before the weapon could be fired.

Something had to be done about improving the ignition method. Finally, the master armorers—who already knew how to build intricate, accurately fitting plate armor and

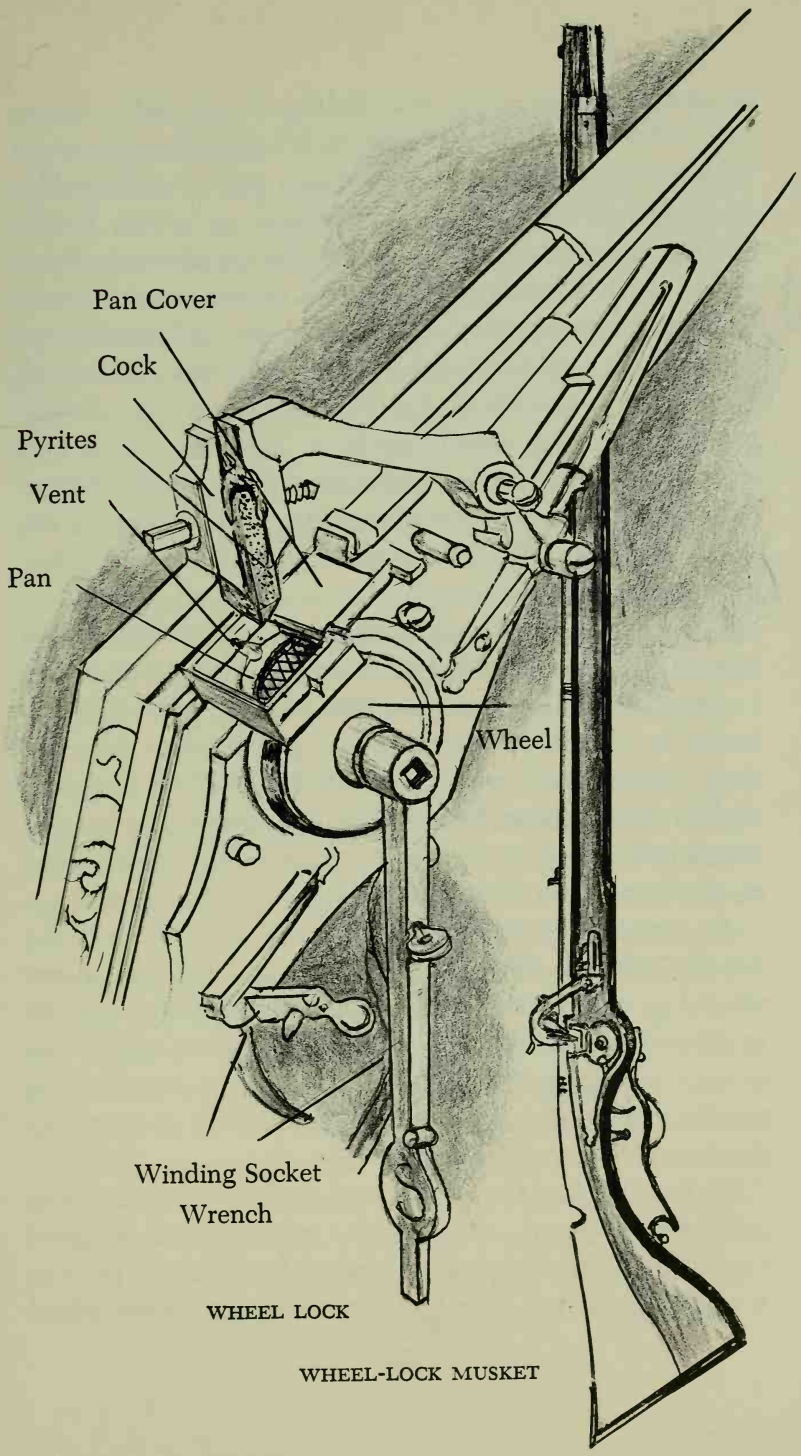


MATCHLOCK AND MATCHLOCK MUSKET

whose business was falling off because their product wasn't giving the knights protection from the new firearms—gave the matter some thought. Or someone did. As usual, no one knows for sure who first realized that the method man had used for hundreds of years to start cooking fires—striking flint against steel to create sparks—might be applied to lighting the priming powder in a gun.

Perhaps Leonardo da Vinci, whose sketchbook was filled with so many future wonders, deserves the credit. He made four pages of sketches of such a mechanism, which came to be known as a *wheel lock* sometime in the last quarter of the fifteenth century. The earliest combination wheel locks and crossbows may have been made in Venice as early as 1510, and one still exists that was made between 1521 and 1536 for Ferdinand, brother of Emperor Charles V.

The wheel lock was a Rube Goldberg contrivance full



WHEEL LOCK

WHEEL-LOCK MUSKET

of wheels, chains, cogs, and sliding covers and a spring had to be wound up with a wrench before the gun could be fired. They were so expensive that only wealthy nobles could afford to buy one and keep it in repair. Oddly enough the idea of the simple, reliable flintlock didn't arrive until a hundred years later. Even so, the wheel lock had a tremendous impact on war and on society. The telltale and unreliable match had been eliminated, the powder was somewhat protected from wind and rain, and the gun was usually ready to fire. The wheel lock which could be carried concealed, supplanted the dagger and sword as an effective means of assassination and, because of this, in 1517 the Emperor Maximilian tried to forbid its manufacture.

The wheel lock had a cock or arm something like a serpentine, but, instead of a match, it held in its clamp a piece of iron pyrites, and the priming pan was protected by a sliding cover. The gun got its name from the small steel wheel with a serrated rim that projected slightly into the pan from below. This wheel, on an axle at one side of the gun, was connected to a spring by a small chain much like a small bicycle chain.

To prepare for firing, the gun was loaded down the muzzle, the pan filled with powder, and the wheel was wound up on the axle with a small winding socket wrench or spanner and held under tension by a safety catch. The wrench was sometimes combined with a powder flask or screwdriver to help reduce the number of gadgets the musketeer had to keep track of.

To fire the gun the trigger was pulled, which slid the pan cover forward, exposing the powder, and snapped the cock holding the piece of pyrites forward and pressed it against the wheel. The catch released, so that the wheel

spun around, throwing a shower of sparks into and igniting the priming powder.

Important as this improvement was, the gun still had a long way to go. The wheel lock was too complicated, fragile, and costly to be issued to infantry. In the sixteenth century each wheel lock cost the present-day equivalent of anywhere from $300 to $650. Many of these guns were custom-made masterpieces of intricate decoration covered with fine engraving and carving and inlaid with mother of pearl, ivory, and even gold and silver.

A short-barreled version, however, was very useful to the cavalry. Although mounted men could not handle a matchlock, which needed two hands to fire and could not be reloaded in the saddle, a rider could carry as many as four wheel locks in saddle holsters, loaded and primed. A pistol that could be carried on the person and was ready for instant use had now also become practical.

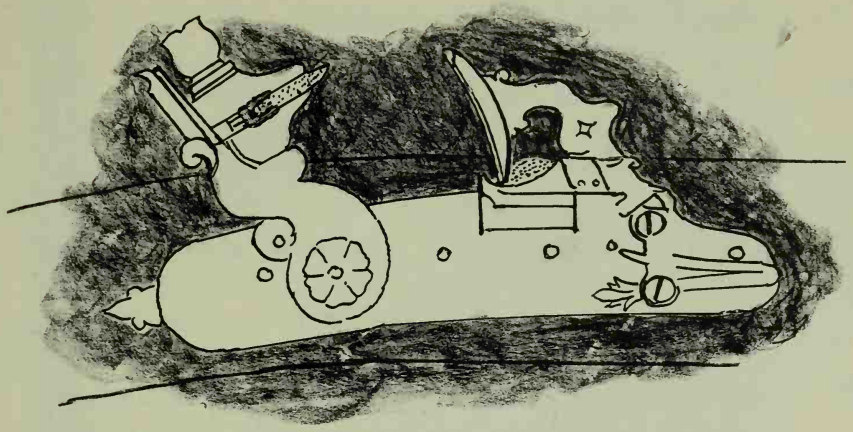
Not long after the introduction of the wheel lock, gunsmiths began devising other methods of using the simple and ancient ignition method of producing sparks by striking flint against steel. Some time before 1550 some Dutch gunsmith discarded the delicate wheel, its elaborate winding mechanism, and its easily lost wrench. He kept the familiar serpentine, fastened a tiny vise to its upper end, and clamped a carefully sharpened piece of flint with a piece of leather around it to prevent slipping between its jaws. He kept the flashpan with its sliding cover but added a new arm in front of the pan, ending in a small steel plate that could be moved down until its lower end rested on the flashpan. When the gun was cocked by pulling back the cock (later called the hammer), a pull at the trigger released a spring that slid the pan cover

back and snapped the cock with its poised flint smartly against the steel battery, knocking it up and sending a shower of sparks into the powder.

Because this action reminded the Dutch of a pecking rooster they called it the Snaphaan, even naming the vise a haan (German: *hahn*), or cock. The plate was called the steel, battery, or hammer. The name of this lock was distorted in other countries to snaphance or snaphaunce. This weapon was a great improvement over the matchlocks and wheel locks, and the Dutch ships trading throughout the sixteenth-century world found it a most profitable item. Countries with developed manufacturing improved on it, but more primitive countries continued to copy it for years. It was still being made in Morocco as late as 1885, long after it had disappeared in Europe.

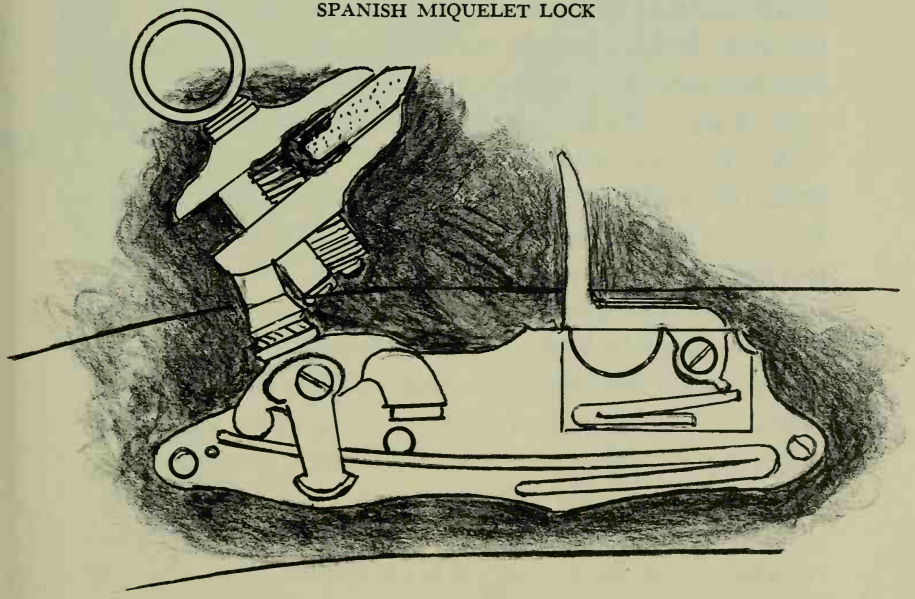
The snaphance was much simpler and cost only about half as much as the wheel lock, but it never became popular; it was still much more expensive than the matchlock. Mid-sixteenth-century European armories still contained thousands of matchlocks in good working order, since junking them in favor of or converting them to snaphances all at once was an expenditure that the defense budgets of national treasuries could seldom afford. Also, two new and superior gun locks were invented at about the same time: the Spanish or miquelet lock and, in the first quarter of the seventeenth century in France, the first true flintlock.

During the sixteenth century, Spanish gunmakers led the world in craftsmanship, both in forging superior barrels and in constructing fine locks. In the miquelet they combined the snaphance functions of the sliding pan cover and a steel at the end of a delicate pivoted arm into one



ITALIAN SNAPHANCE LOCK

SPANISH MIQUELET LOCK



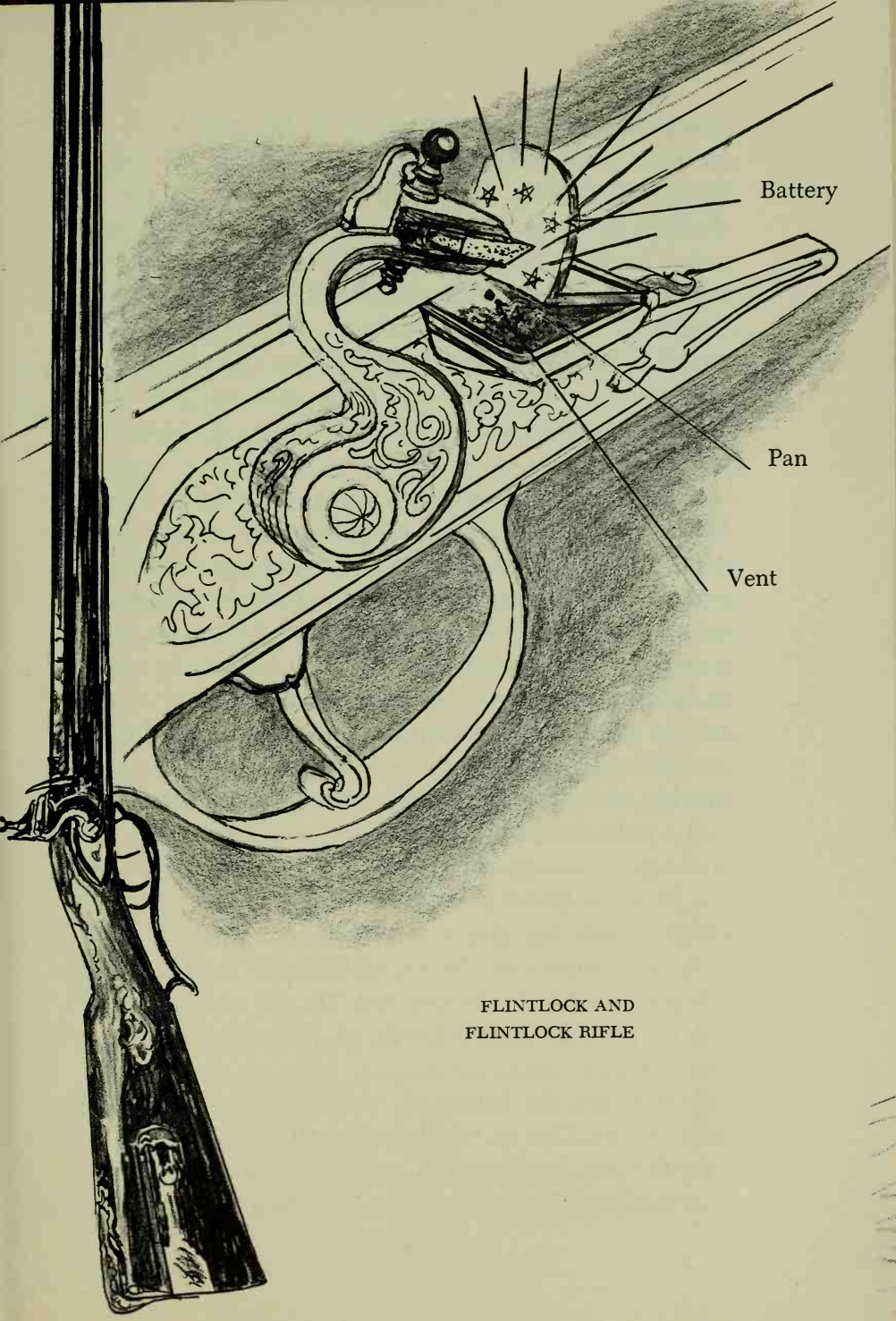
L-shaped hinged piece. The horizontal arm of the L was the pan cover, the upright arm the steel.

The shooter tipped the cover up, primed the pan, snapped the cover down again, and pulled back the cock. The trigger was pulled and the cock snapped forward, striking its flint against the steel of the pan cover, knocking it upward, and dropping a stream of sparks into the primer. This eliminated four more moving parts, and both the mainspring and the cock were on the outside of the lock, which made the gun easier to clean and repair. Until the improved eighteenth-century English flintlock appeared, the miquelet was for years the finest gun in Europe, and the Spaniards used it well into the 1800's.

The final step in ignition by means of sparks was the "true" flintlock. For once all the evidence points to one man and one place: Marin le Bourgeoys and the village of Lisieux in Normandy. The date: 1610–1615. He combined the best features of the L-shaped pan cover and the steel of the miquelet with the inside mainspring and lock mechanism of the snaphance. Then he added a new type of sear (the catch holding the action at cock or half cock). Previous sears had all moved horizontally, sliding across the lock, but Bourgeoys' moved vertically on a pin that gave a more positive action and made the half cock position absolutely safe.

This was the gun that replaced the Spanish miquelet and the matchlock. By 1700 the flintlock was acknowledged to be the best and most reliable firearm in the world. It was standard military equipment among all major powers although eighteenth-century gunsmiths continued to add further refinements.

One such improvement was a flashpan with a channel running across the top and sides to deflect water running



FLINTLOCK AND
FLINTLOCK RIFLE

down the sides of the barrel from the powder in wet weather. Some makers added small shields behind the flashpans to keep burning powder grains out of the shooter's eyes. An Englishman, Henry Nock, invented a patent breech to increase the speed with which the priming flash ignited the main charge. He added a small antechamber behind the breech. Filled with powder that was set off through the vent, it ignited the main charge simultaneously, much faster and with more explosive force. This made shorter barrels and double-barreled guns practical.

A flintlock firearm may look simple and primitive today, but only the most skillful gunsmith could make a really good weapon. Great delicacy of balance was needed; the mainspring had to have exactly the right tension so that the cock would not strike the steel, or frizzen, as it was now called, too hard or too softly. It had to be exactly in balance with the small flashpan spring, which had to be just stiff enough to keep the pan cover closed but not too stiff to prevent the cock from driving it upward quickly and smoothly. Sometimes this flashpan spring had a roller bearing at its tip to prevent the frizzen from sticking. If the temper of the metal in the frizzen was too hard the flint would knock off such tiny particles of metal (sparks are simply tiny white-hot pieces of steel) that they would cool before igniting the powder. If, on the other hand, the frizzen was too soft the flint would cut deeply into it and knock off particles too large to heat well.

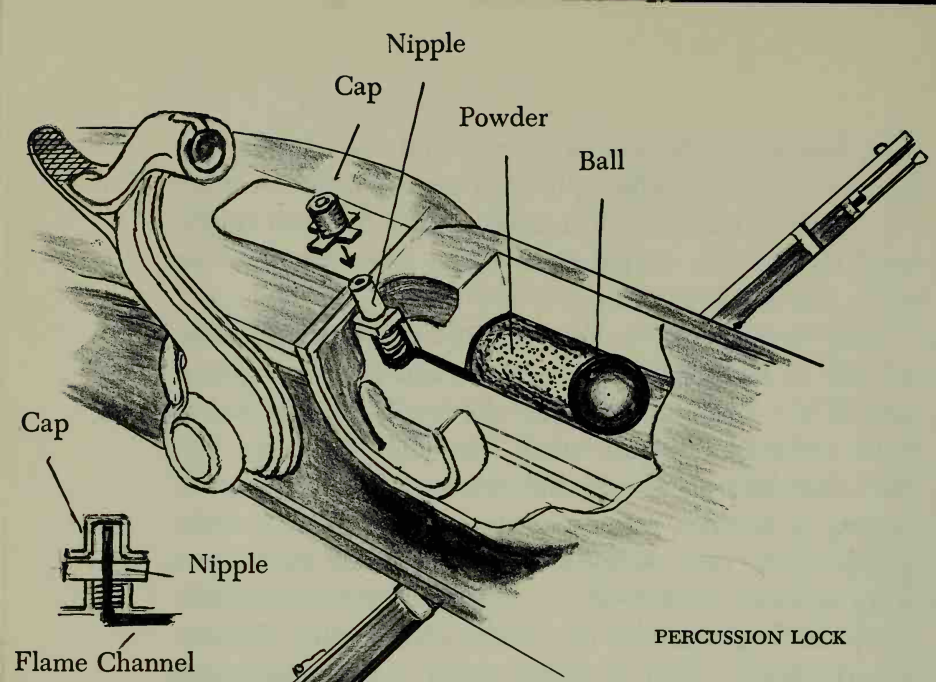
Water was the enemy of any firearm using an open priming pan. One gunsmith prevented water from getting into the pan by placing it *under* the barrel. As long as the pan cover was closed the priming remained in the

pan, but when the gun was fired and the frizzen was knocked back, the priming powder started to fall out. Yet the ignition was so fast that when the flint struck the steel the powder caught fire, sent a flame through the vent, and set off the charge every time.

Many people believe that a flintlock gun was unreliable, subject to flash-in-the-pan misfires, and that it required several minutes to load, prime, and fire. If the gun was in good condition, the flint sharp, the steel clean and dry, the vent unclogged, and the priming powder of good quality, a flintlock was as reliable as a modern weapon except in the rain. As for speed, well-trained musketeers were expected to fire off a round every fifteen seconds.

By the beginning of the nineteenth century, firearms experts thought that the ultimate in firearms had been achieved with the latest flintlocks, but they had not counted on the Reverend Alexander Forsyth, a Scot who lived in Belhelvie, Aberdeenshire. Forsyth was an enthusiastic amateur chemist and he loved hunting. He had noticed, while bird shooting in Aberdeenshire, that the flash of the powder in the pan an instant before his fowlingpiece went off often alerted the birds into changing their flight before a shot could reach them.

He had read of the experiments of the great French chemist Claude Louis Berthollet, who had discovered that certain chemicals, the fulminates of mercury or silver, and gunpowder made with potassium chlorate could be exploded without using an open flame merely by placing them on an anvil and striking them sharply with a hammer. Forsyth saw the possibility of using this principle to fire a gun, and in 1807, with the help of his friend, steam engine inventor James Watt, he took out a patent on the use of fulminate as a priming for guns. In



PERCUSSION LOCK

U.S. PERCUSSION-CAP MUSKET MADE 1861

FORSYTH PERCUSSION LOCK WITH
"SCENT-BOTTLE" PRIMING MAGAZINE

Forsyth's percussion lock, the usual flashpan was omitted in favor of a tiny magazine shaped like a perfume bottle pivoted alongside the gun barrel. His gun was popularly known as the "scent-bottle gun." When the magazine was rotated a small amount of fulminate fell into a plug at the top connected by a vent to the main charge. After it was rotated back it presented a small plunger from the plug to the cock, which no longer had jaws for a flint but only a simple hammer. When the trigger was pulled the hammer struck the plunger and drove it down on the fulminate, which exploded, sending its flame to the main charge. The magazine contained enough fulminate for several shots.

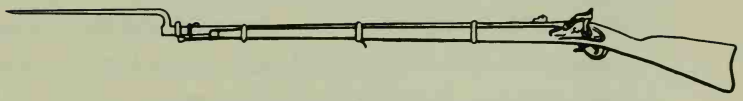
The percussion gun worked well and Reverend Forsyth set up a partnership in London to manufacture it. Several variations in his method of detonating the fulminates were later tried in an effort to eliminate the danger of having it all explode in the magazine at once. One inventor filled a copper tube with it, pushed it down the vent and set it off with a sharp pointed hammer. Another gunsmith, Joseph Manton, patented a pill lock in 1816; he mixed the fulminate with gum arabic and made pellets of it that were placed in a recessed nipple. Still others sandwiched the fulminate between two pieces of paper like the cap used in cap pistols. One man put dabs of fulminate along a strip of paper tape that was coiled in a container on top of the gun to be pulled out and exploded a dab at a time.

Some time between 1814 and 1820 (several gunmakers have claimed the credit) the *percussion cap* was invented. A small quantity of fulminate was contained in a tiny copper shell covered by a tinfoil disc and sealed with a drop of shellac. The cap was placed on a nipple from

which a tiny vent led directly to the charge. When the cock struck the cap a flame spurted down the vent and fired the gun instantly. There was no flash at the breech, no delay in firing, no loss of compression, and complete protection from dampness.

At last a gun had been developed that could be fired in a rainstorm, never missed fire, and had no backflash to endanger the shooter's eyes. It proved so popular that within twenty-five years a flintlock gun had almost become a curiosity. The percussion-cap gun was not superseded until the brass cartridge containing its exploder inside appeared in the middle of the nineteenth century shortly before the American Civil War.

6 Rifles and Breechloaders



In the sixteenth century, at about the time of the invention of the wheel lock, a discovery was made that eventually affected the design of weapons more than anything since gunpowder itself. For many years gunsmiths had cut parallel grooves, called *rifling*, inside the bores of guns. Then someone, name unknown, tried cutting the grooves in a spiral, which made the bullet turn as it traveled through the bore so that it emerged spinning.

The spin overcame the often very erratic flight of previous projectiles. The bullets now shot straighter and farther than from a smoothbore using the same powder charge. For three hundred years, until after 1742, nobody knew just why; there was as yet no science of ballistics. Some thought that the demons who spoiled good marksmanship by riding bullets as they sped toward their target could not remain astride a spinning projectile. Others took the opposite view, believing that, since guns were an invention of the devil, the best ones were aided by the forces of darkness and a demon was even more comfortable on a spinning ball.

The greater accuracy was, of course, due to the gyroscopic effect and the fact that a tight-fitting ball cannot

bounce around in the barrel and leave the muzzle erratically. Every new advance, however, presents new problems. Although they appreciated the improved aim and increased range, shooters objected that a rifled gun was difficult to load. Since the bullet had to be slightly larger than the bore so that it could grip the rifling, a mallet was needed to hammer the ramrod down the muzzle and drive the bullet down the bore to the breech. Ramrods, being wooden, sometimes broke at a critical moment. Also, forcing the bullet with mallet and ramrod tended to flatten the bullet out of the round and offset some of its new accuracy. The loading method was tedious and time-consuming, and after a few shots the barrel became so fouled that the ball couldn't be forced down into it without swabbing out the bore.

One solution in the early seventeenth century was to use a smaller bullet and wrap it (as with the arrow fired from de Milemete's vase gun) in a greased patch of leather or cloth. The patch gripped the rifling and made the ball spin. This method was used mostly by the American frontiersmen whose favorite weapon was the Kentucky rifle.

Another way of expanding a lead bullet was achieved by several inventors in the early nineteenth century. They redesigned the bullet and, instead of the traditional round balls, used a cylindrical shape, with one end pointed and the other hollowed out. These hollows contained plugs of wood or iron that were driven forward by the explosion into the softer lead of the bullet, spreading its sides so that it was forced into the rifling grooves.

Another gas-expanding bullet, designed by Captain C.-E. Minié of the French army, used a plug in the shape of

a small iron wedge that made the slug expand uniformly on all sides. Thus a paper-wrapped cartridge, which also held the bullet, could be rammed down the muzzle easily. The Minié bullet, although widely adopted, was found to have faults: the iron wedge sometimes separated from the bullet, endangering bystanders—and it was expensive. At almost the same time an American, James Henry Burton, experimenting at the Harpers Ferry armory, designed a bullet that expanded without a plug. Even though Burton's bullet was an improvement and was widely used, Minié got the credit because the troopers using it miscalled it a "minny" ball. Such bullets can still be picked up on the Gettysburg battlefield.

Before any further significant improvement could be made in rifle making, a new breakthrough was needed. Breech-loading cannon and hand guns had been tried off and on almost since the beginning of firearms; Henry VIII had two in 1532. They were never successful because the metals and metalworking techniques of the time did not enable machanics to achieve the close tolerances needed to produce a gas-tight breech. The breech mechanisms always leaked compression and often, after a few firings, even dangerous flames.

Early in the nineteenth century, gunsmiths again began experimenting with breechlocks. Muzzle loading was a slow procedure and was impossible as long as the gunman was crouching or lying down, as he often was in battle to avoid enemy fire. Also, in the excitement of action a paper cartridge might be loaded upside down, making the gun useless until the cartridge was wormed out, or more than one cartridge might be loaded, with the subsequent danger of bursting the barrel.

FERGUSON BREECHLOADER LOCK (Priming Pan Omitted)

OFFICER'S FERGUSON RIFLE
Made By Durs Egg, London, 1777

Although the first breech-loading cannon were used early in the fifteenth century, four hundred years were to pass before the problem was solved. Some way had to be found to insert the cartridge from the breech end. Several methods were tried. In the John Hall rifle (patented in 1811), a tip-up block was put in the top of the breech to permit the insertion of a cartridge. United States troops using Hall's rifle during the Mexican War of 1846–48 discovered it had an added attraction—the removal of one screw allowed them to take the entire block from the rifle and use it as a very short-barrelled pistol that was lethal at short range in barroom brawls.

Another breech-loading design was a threaded plug that ran right through the barrel vertically from bottom to top and had to be unscrewed to open the loading chamber. But not only could the plug be easily dropped and lost, the thread in the plug swelled and became fouled with carbon when the gun was fired. This meant that the plug could not be unscrewed with the fingers alone. In 1704 Isaac de la Chaumette, a French engineer, designed a breech whose plug did not need to be removed all the way in order to be opened; when it was turned, an opening into the loading chamber appeared in the top of the barrel. Ball and powder were dropped in and then it was closed. The lower end of the plug was attached to the trigger guard that acted as a handle with leverage to help turn it.

During the American Revolution the Kentucky rifle so consistently outranged and outshot the standard British Brown Bess musket that it led a young Scottish army officer, Patrick Ferguson, to design a remarkable breech-loading rifle, an improvement on La Chaumette's. It also

had a screw plug, but part of it was left unthreaded so that when the breech was closed its smooth surface formed the back of the bore and prevented serious fouling in the threads.

In 1776 Ferguson demonstrated his gun to British ordnance officials and proved to them its vast superiority to the ordinary musket. Later a second demonstration was held in a driving rainstorm that would have made a flintlock impossible to fire. Ferguson fired at a target some two hundred yards away for several minutes at a rate of four or five times a minute, sometimes while walking rapidly. In one minute of rapid-fire shooting he fired six shots per minute. Then came the convincer: he poured water into the pan, wetting all the priming powder, wiped it out, and had the gun firing again within half a minute. Despite these adverse conditions he missed the target only three times and did not misfire once.

Within weeks after this exhibition the British ordnance officials ordered two hundred Ferguson rifles. When these were ready the rifle was demonstrated to the royal family at Windsor. Shortly afterward a special unit was organized that sailed under Ferguson's command in March of 1777 for America, where the revolution had been in progress for two years.

Ferguson's rifles performed so well in their first engagement at Brandywine Creek in September that the Hessian General Knyphausen, to whose column Ferguson's men were attached, sent a commendation to General Howe. But Ferguson was wounded in the battle; an American bullet shattered his right elbow and crippled the arm. With its commander facing a possible amputation, the unit was disbanded by Howe, the men returned

to their original regiments, and Ferguson's rifle was forgotten. If the regular British line companies had been supplied with this gun George Washington might never have become the Father of His Country.

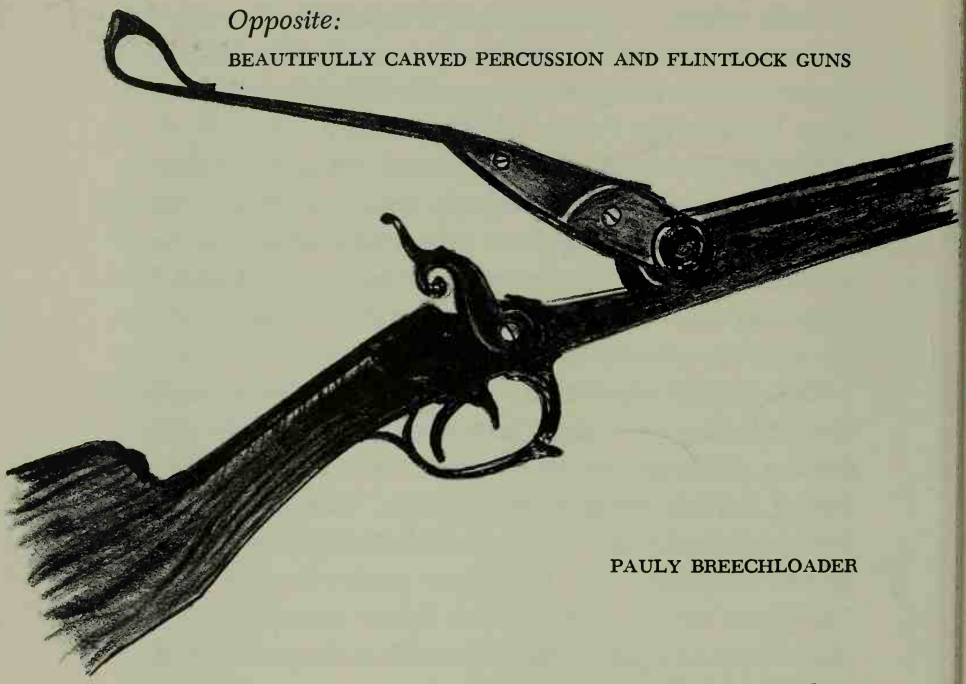
The Ferguson rifle today is one of the greatest firearm rarities; no one knows what happened to the two hundred rifles. The soldiers may have taken them when the corps was disbanded or they may have been stored and forgotten in some warehouse. The greatest weapon of the Revolution virtually vanished.

During the nineteenth century the military wanted breechloaders that fired cartridges, so hundreds of inventors produced many different kinds of breechblocks, sliding breech bolts, tilting barrels, bolt actions, trapdoors, and falling, rotating, and tilting breechblocks. These variations fired cartridges made of paper, metal foil, sheet metal, even rubber. Some were paper cartridges with copper or brass bases but they all failed to provide a really gas-tight seal.

These inventors apparently didn't know that this problem had been solved fifty years earlier by a Swiss inventor, Johannes Samuel Pauly, whose major step forward in firearm design had been discarded because his rifle itself was too delicate and complicated to withstand rough military handling. Pauly had realized that the solution lay not in the gun but in the ammunition. He designed a cartridge of soft metal with a flange around its base that expanded when the gun was fired and thus formed a tight seal. His cartridge was detonated by the blow of a hammer upon a small charge of percussion powder. The powder was in a tiny pan outside the cartridge that connected with the propellant by a narrow channel. Although his first cart-

Opposite:

BEAUTIFULLY CARVED PERCUSSION AND FLINTLOCK GUNS

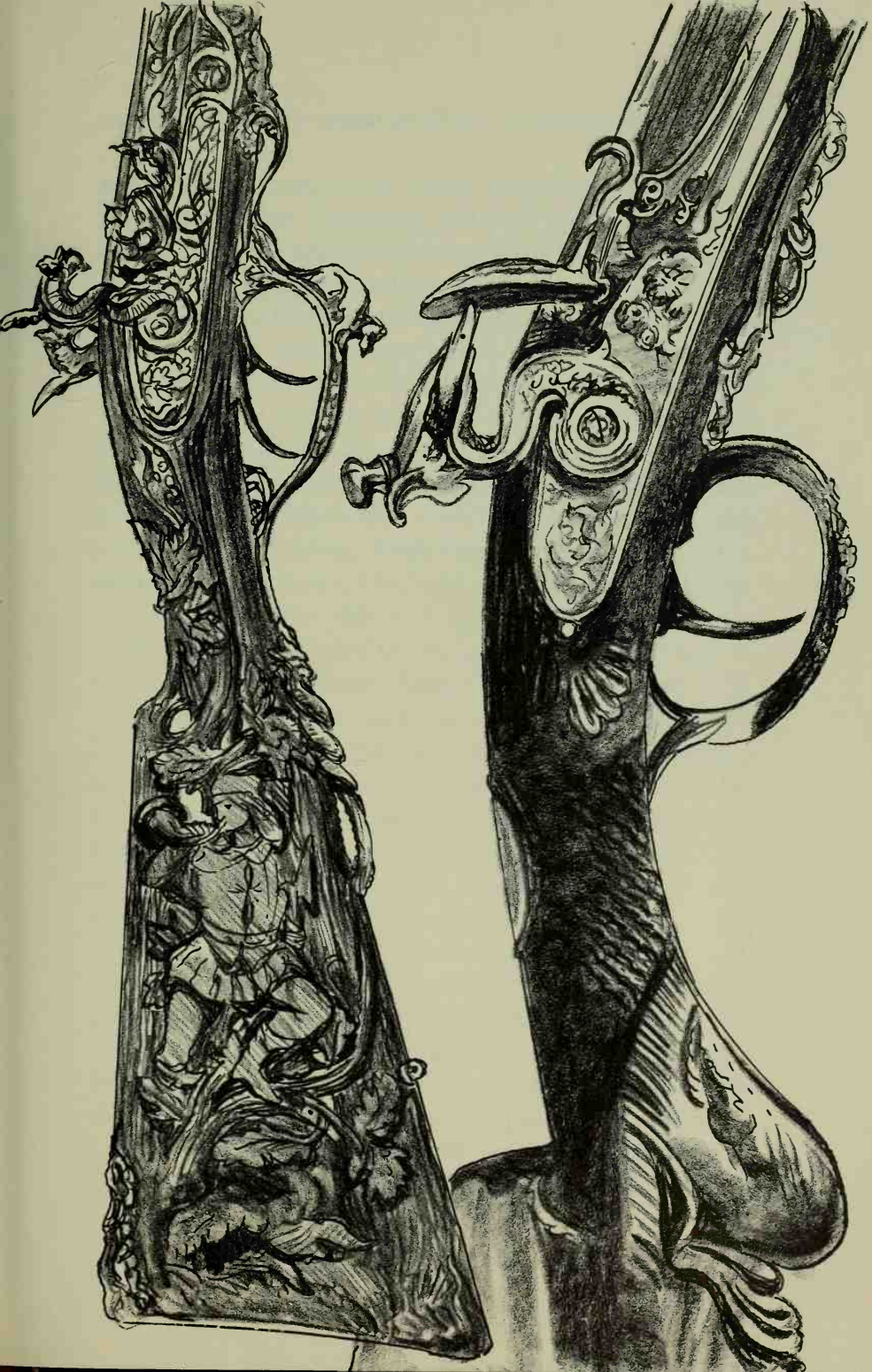


PAULY BREECHLOADER

ridges had paper bodies crimped to brass bases, they worked exactly like the modern center-fire brass cartridge.

Pauly's invention eventually changed the thinking of gunsmiths all over the world, and in 1837 one of his workmen, Johann Nickolaus von Dreyse, developed the *needle gun*—a weapon in which a sharp steel needle was driven by a hammer into a cartridge and struck and detonated a percussion cap inside it. This, the first military cartridge-firing breech-loading rifle with a bolt action, was officially adopted by the Prussian army in 1848.

By the latter half of the nineteenth century the single-shot breech-loading rifle was gaining favor. In America Winchester, Colt, Spencer, Henry, Remington, and Sharps

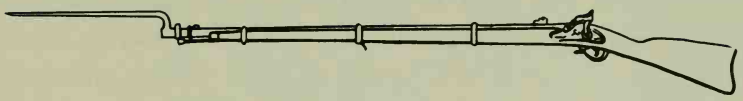


were familiar names to soldiers, peace officers, sportsmen —and outlaws.

There were still game birds, ducks, geese, and quail to be brought down, and the gunsmiths were turning out new shotguns for hunting to replace the antiquated flintlock and percussion-cap smoothbores. The new guns were single, double-barreled, and over-and-under breech-loading weapons firing brass and paper shells.

The day of the muzzleloader was over by 1870. Because technical advances now came so quickly, the single-shot breech-loading rifle was soon made obsolete by the new weapon, the repeater, which could be fired more than once after one loading.

7 Repeaters and Machine Guns



From the very earliest days of firearms, gunners had dreamed of a weapon that could be fired several times with only one loading. Beginning in the early fifteenth century, gunsmiths tried to build such weapons, and they devised some remarkable and ingenious repeaters.

The first attempt was to arrange multiple barrels in a row clamped to a wooden base. Each barrel had its own vent and could be fired singly; or as fast as a match could be swept across the vents; or, using a train of powder, all at once. This arrangement resembled the pipes of an organ, and it was know as the *organ gun*. These multi-barreled guns were also called *ribaudequins*, a word that was in use before gunpowder to mean a scythed war chariot that carried several weapons.

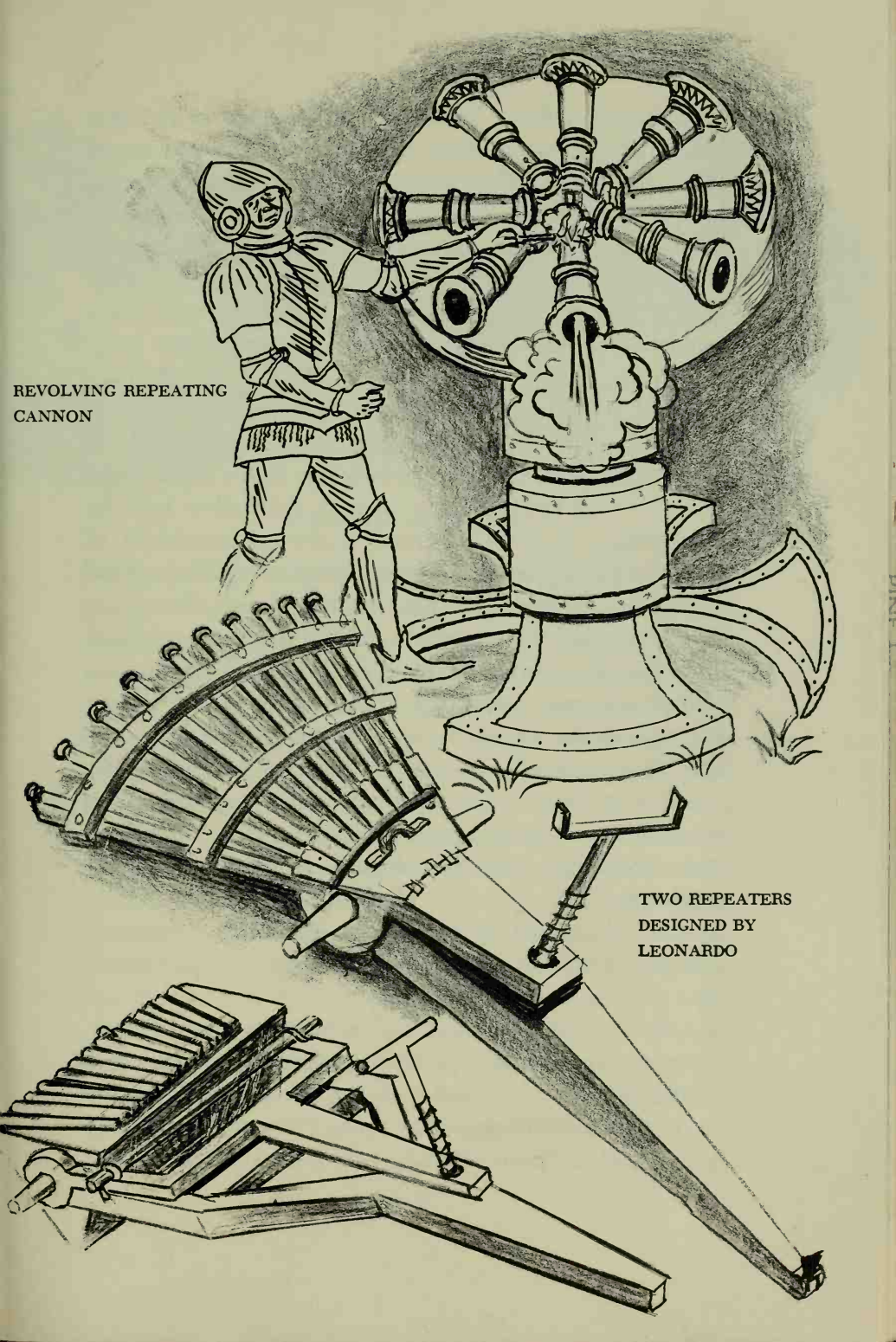
A ribaudequin with ten barrels is mentioned in a 1339 account, and in 1387 the Duke of Verona, obviously a believer in massive firepower, had three ribaudequins with 144 barrels each. They were arranged in three tiers and thirty-six of the barrels fired at once. In another version the barrels were mounted like the spokes of a wheel on a turntable. Each barrel was fired as it was turned toward the target. It is unlikely that very many of these con-

traptions were made because if stray sparks set off several or all the charges at once it would have caused more casualties for the home team than among the enemy.

Leonardo da Vinci, of course, had some ideas about multiple-firing guns. His sketchbook shows three variations, one with fourteen barrels in a row mounted on a wheeled carriage, another with ten barrels fanning out in a quarter circle, and a third with a triangular solid block pivoted on an axle and with a row of barrels on each of the three faces of the block.

The revolving cylinder, principle of the revolver, was already being adapted to the matchlock and wheel-lock muskets early in the sixteenth century. On some guns the cylinder was made of full-length barrels; in others a short cylinder holding the charges revolved and was locked in place by a spring when one of the chambers in the cylinder lined up with the bore in the barrel. Such weapons undoubtedly leaked gas and flame from their breeches and were probably both inefficient and extremely dangerous to the shooter.

An almost incredible rapid-fire weapon was described in England in 1580 and seems to have been known and frequently tested throughout Europe during the next century. It fired a number of shots continuously from the same barrel and was called, for obvious reasons, the *Roman-candle gun.* It was loaded by pouring a charge of powder down the barrel, and then a special bullet that had a hole drilled through it from tip to base filled with fuse compound was dropped on top of the charge. Next a second charge of powder and another bullet were put in on top of the first, then another and another until the bore was filled. The topmost charge was exploded by a lock and vent near the gun's muzzle. As each charge



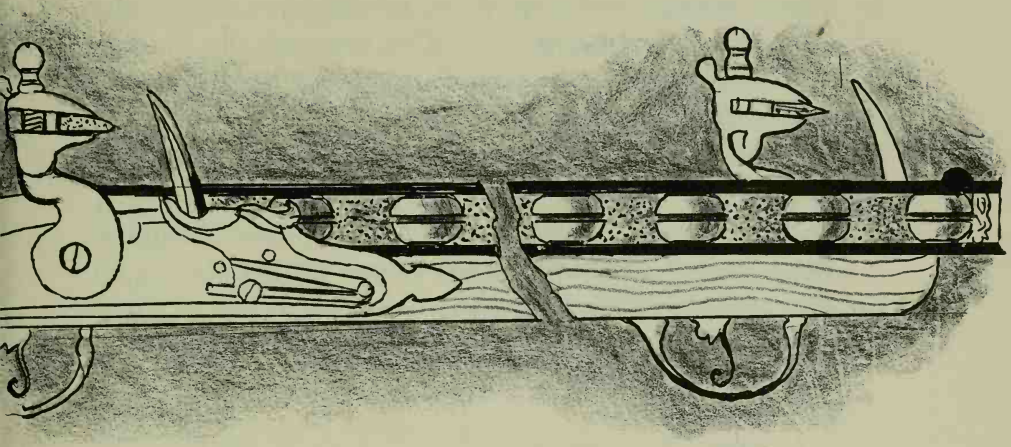
REVOLVING REPEATING CANNON

TWO REPEATERS DESIGNED BY LEONARDO

fired it sent a flame back through the hole in the next bullet, which exploded the powder behind it and set off the charge behind that, and so on. The gun had a second lock at the breech so that it could also be fired in the usual way after the multiple charges had fired, as it would take too long to multiple-load it again during a battle.

In about 1640 the first true magazine gun, a really sophisticated and efficient repeater, appeared—the product of the Kalthoff family of gunsmiths, originally from Solingen in Germany. A verse engraved on one of their wheel locks boasts that the gun could fire from six to thirty shots. It had two magazines, one in the stock under the barrel for the balls, the other in the hollow butt for the powder. One forward and backward movement of the pivoted trigger guard, which acted as a lever, turned a cylindrical breech chamber so that one bullet and a charge of powder dropped into it from the two magazines. Then the chamber was pushed back in position, the pan primed, the gun cocked by another turn of the trigger guard, and the weapon was ready to fire. The gun was safe, fast, and reliable—and it was two hundred years ahead of its time. Unfortunately, it was expensive because its complicated gears, springs, and cams were difficult to make, and fouling seriously clogged its movements. Other smiths built guns of this type, including John Pim of Boston, whose gun fired eleven bullets in two minutes, and John Cookson, also of Boston, whose weapon was a nine-shot repeater.

A mechanical genius and prolific inventor, Walter Hunt, patented a new bullet (1848) and a new repeating gun (1849) called a volitional repeater, which contained the basic principles of many later arms. His cylindrical bullet had a conical tip and its base was hollowed out to hold



THE ROMAN-CANDLE GUN

the propelling charge. The cork that held the powder in place was pierced by a hole through which a separate priming flash reached the charge. The magazine was under the barrel and a spring pushed the bullets back one at a time to the loading chamber into which they were lifted by a lever. Another of Hunt's innovations was the gun's straight-drive firing pin, which replaced the customary cock and hammer.

Several other inventors, among them Smith and Wesson, added further refinements, and in 1854 a corporation was formed to manufacture Hunt's gun. Among forty other investors was Oliver F. Winchester, whose skill in financial matters was a very important factor in the development of the gun and of the company which he eventually controlled first as the Volcanic Repeating Arms Company and, later, as the New Haven Arms Company.

He put a skilled mechanic, Benjamin Tyler Henry, in charge as manager and in 1858 asked him to design a better cartridge. Henry perfected a .44 rim-fire metal-

cased cartridge and altered the volcanic gun so that the cartridge could be used in it. This gun, actually the first Winchester, was manufactured from 1860 to 1866 as the Henry rifle. It was a .44 caliber 9.25-pound gun and was 43.5 inches long, carrying sixteen cartridges in a tubular stock below the barrel. It was purchased by the War Department and several states, and about ten thousand were made. General Sherman's troops carried Henrys on their march to the sea, and the rebels called it "that damned Yankee rifle that was loaded on Sunday and fired all week." It was also popular in Kentucky and Missouri, and further west.

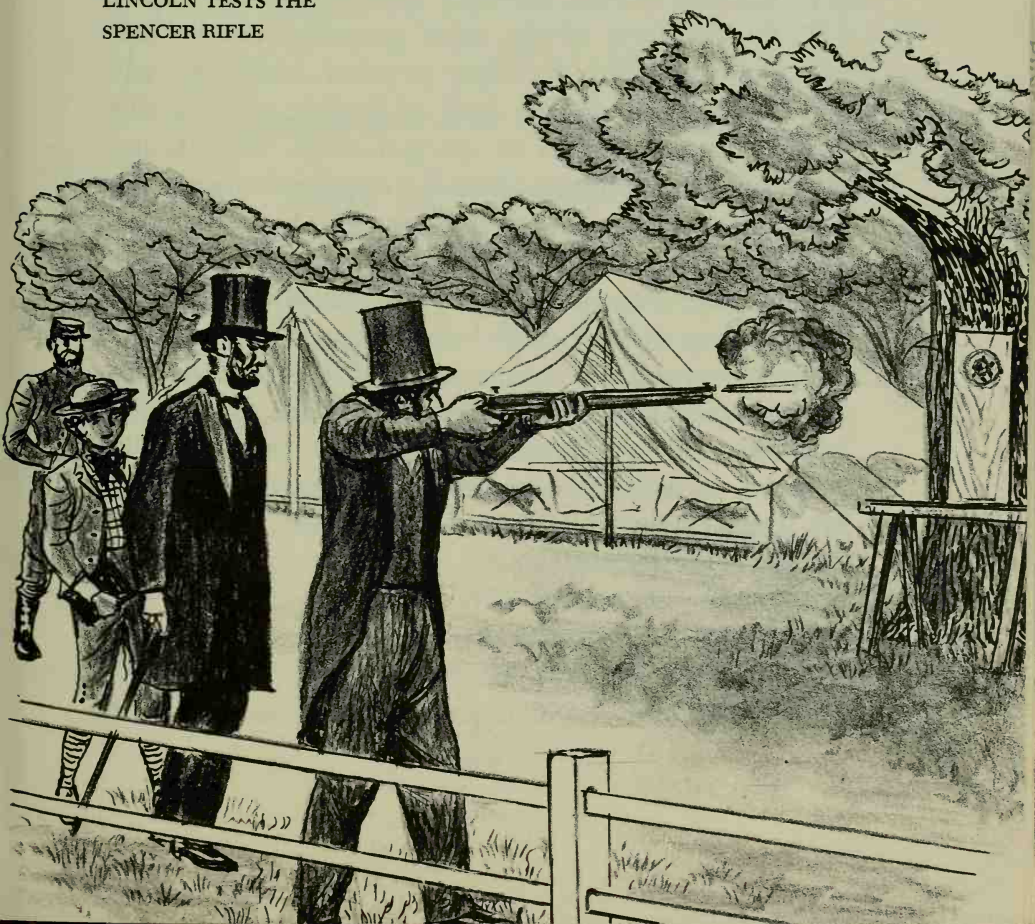
In 1866 when Winchester again reorganized his company as The Winchester Repeating Arms Corporation, the Henry rifle, with a few improvements was reissued as the Winchester, Model 1866. After that all the company's succeeding repeaters were lever-action weapons with a tubular magazine below the barrel and were called Winchesters. The Model 1873, or '73, was probably America's best-known gun. It was used by frontiersmen, hunters, and soldiers and was a great favorite with the Indians, who, according to Buffalo Bill, would give more for a Model '73 Winchester than for any other rifle.

During the war fat government orders could be obtained for successful guns, and smiths were encouraged to build new models, among them the famous names already mentioned as well as Remington, Colt, and Spencer.

Christopher Spencer, who may have been Mark Twain's model for his Connecticut Yankee, patented a new gun in 1860. This was the first magazine repeater to be offered to the government when the Civil War broke out. The navy tested the gun and placed an order,

but General Ripley, chief of Army Ordnance, was a stuffy traditionalist and turned thumbs down. Spencer went over Ripley's head to President Lincoln, who fired the gun himself and told Ripley to order it. He stubbornly ordered as few as possible, and still used delaying tactics even after the men in the field demanded more Spencer repeaters. Spencer saw the President again; Lincoln dropped his work, put on his hat and accompanied Spencer to a field where he personally tested the gun, and within two weeks appointed a new ordnance chief. Before the war's end the government had bought more than a hundred thousand Spencer guns.

LINCOLN TESTS THE SPENCER RIFLE

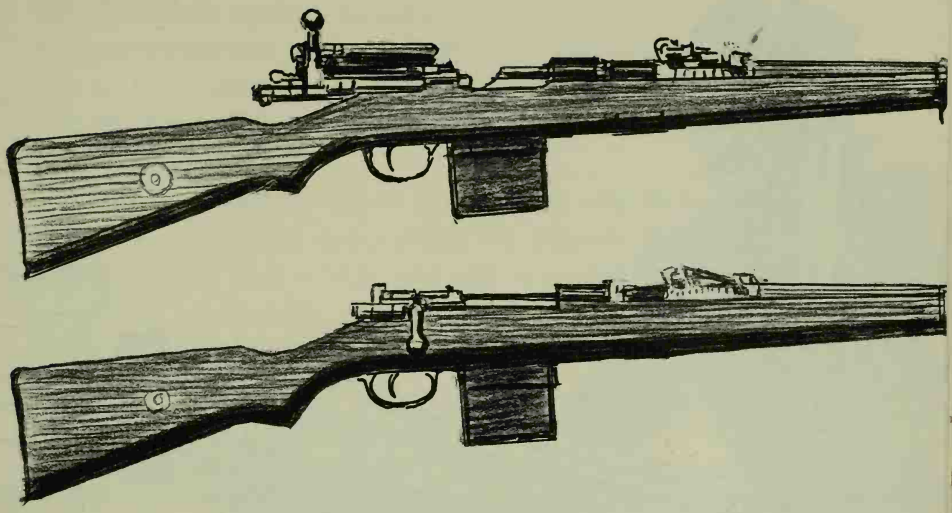


The final development in sporting and military repeaters was the bolt action, which was rugged, simple, easy to clean, and could be worked more easily by a man from a prone position than could a lever action. Peter Mauser developed a bolt-action single-shot rifle in the 1860's that became the model for all succeeding guns of that type. In 1879, James Lee invented a new box magazine located under the bolt in front of the trigger guard to replace the tube magazine in the stock. Cheap, efficient, and easy to load, it soon became standard all over the world. Then the cartridge clip was invented. It held five or more cartridges in one pack and could be slipped into the box magazine in one motion. This seems to be the final word in manually operated repeating rifles.

Today the force of the gases generated by the new and more powerful smokeless powders inside the gun barrel is used to do the work of loading, cocking and ejecting cartridge cases or shotgun shells. The shooter merely pulls the trigger. These developments opened the way to the machine pistol, the light and heavy machine gun, and the rapid-fire cannon.

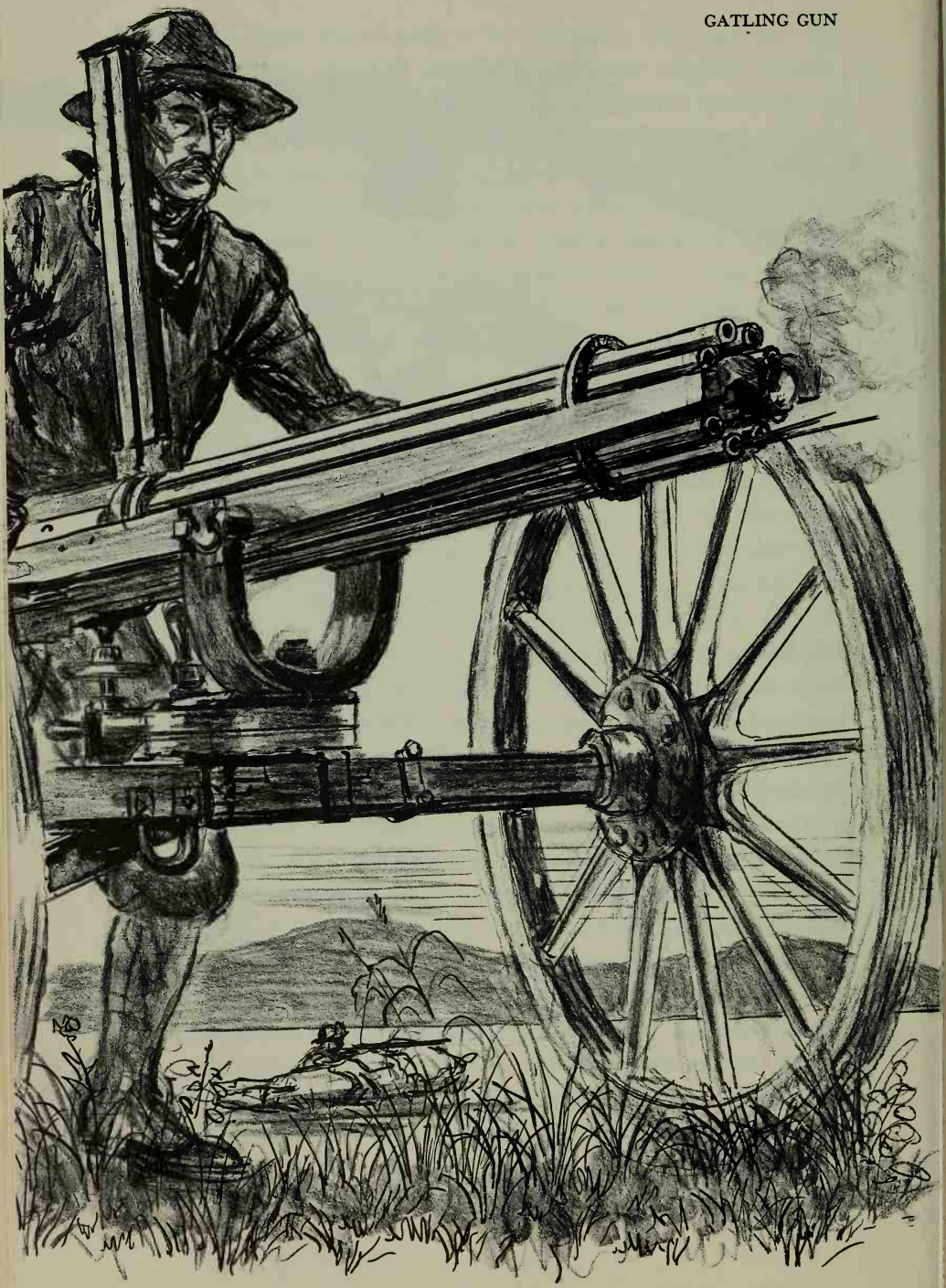
Before the invention of the metal, self-contained cartridge and nonfouling smokeless powders, many gun designers who tried to build quick-firing weapons other than shoulder pieces were limited to *pepperboxes,* multibarrel weapons with a single preloaded charge in each barrel, or a *revolver* in which a cylinder with chambers turned and brought each charge up to, and in line with, the lock and the single gun barrel.

Both have been made since the latter part of the sixteenth century. In Venice there exists a matchlock pistol of 1548 with three revolving barrels. Early wheel-lock pepperboxes and revolvers have survived, as have two



MAUSER BOLT-ACTION MILITARY RIFLE

snaphance revolving carbines, one dated 1597. As we have seen, most of the nonrevolving gun mechanisms were complicated; revolving guns were much more complex but inventors kept trying. In 1718 the English lawyer James Puckle patented an oversize revolver mounted on a tripod. Behind its single barrel was a revolving cylinder; there were several interchangeable ones carrying different numbers of chambers loaded with powder and ball. The cylinder was turned by hand until a loaded chamber lined up with the barrel and a crank at the back pushed it against the breach to make a gas-tight joint. It was fired either by slow match or flintlock. In a 1722 test during heavy rain it fired sixty-three shots in seven minutes. Some of its interchangeable cylinders were equipped to fire round shot against Christians and others to fire



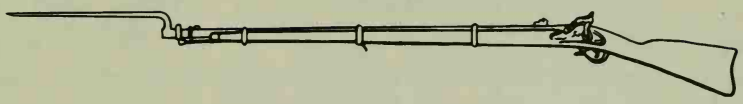
square bullets against infidels, who were considered to be more vulnerable to these. Only three examples remain: two in the Tower of London and one in the Tojhusmuseet in Copenhagen. There were few sales and the company failed.

A more successful weapon of this type was Richard J. Gatling's multibarrel gun, which he offered the Union Army in 1861 but which was not accepted until that ponderous reactionary, General Ripley, was discharged in 1866. Thereafter the army used it even as late as the Spanish-American War. The four to ten Gatling barrels, positioned as a cylinder and revolved by a crank, were fed with cartridges from a hopper above and ejected automatically below. The Gatling gun saw service in the Civil War and later was adopted by the British in 1871 for use in the Zulu war even though it had the bad habit of jamming. By 1876 a five-barreled .45 model fired seven hundred rounds per minute and sometimes a thousand in short bursts. Electrically driven some twenty years later, it fired three thousand rounds per minute. The Gatling gun was successful in some ways—its multiple-barrel system fired rapidly and kept cool—but its weight and the fact that it often jammed made it obsolete as soon as a single-barrel weapon that could fire rapidly was perfected.

Hiram Maxim built the first true machine gun in 1884. He harnessed the power of the recoil from one shot to expel its empty case, reload and cock the weapon, and at the same time to bring another cartridge into position from a belt containing hundreds. The gun continued to fire as long as the trigger was held in firing position and bullets remained in the belt.

His lead was followed by many other inventors, among them Hotchkiss, Lewis, Browning, and Vickers. They developed air- and water-cooled guns operated by gas or recoil and fed from drums, hoppers, or belts or by straight clips. By World War II light portable machine guns like the Thompson submachine gun (made famous by Al Capone and his boys as the "tommy gun"), and the machine pistol, .30 and .50 caliber heavy machine guns, antiaircraft guns like the Bofors and Bren, and the small automatic cannon used in planes had become so deadly on the ground, at sea, and in the air that military tactics have had to be changed constantly.

8 Pistols and Revolvers



The pistol has had a long and colorful history. At first a massive weapon, sometimes two feet long, it was far from being a pocket piece. Although heavy it was far handier to a horseman than the clumsy arquebus; it was used mostly by mounted men who carried it in a holster strapped to the saddle and was therefore called a horse-pistol.

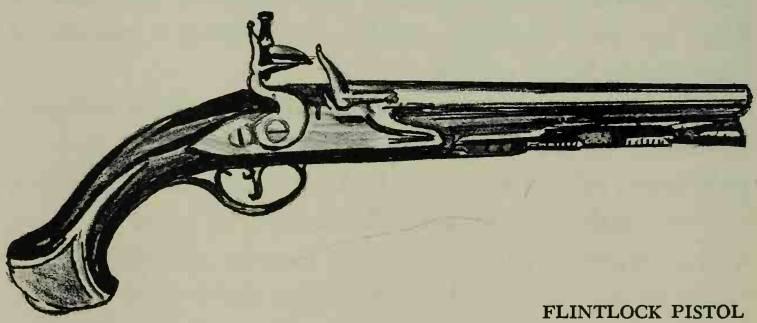
To the layman the pistol has always been associated with deeds of action and derring-do. Swashbuckling pirates sometimes festooned themselves with eight or ten small pistols thrust into sashes or belts when they boarded a ship because a flintlock pistol took too long to load in close quarters. Highwaymen who waylaid travelers or held up mail coaches usually brandished a couple of formidable horse pistols.

Naval boarding parties swinging their flashing cutlasses assaulted enemy ships during the age of sail, led by gold-laced officers firing flintlock pistols. In the eighteenth century dashing dandies settled affairs of honor at dawn with a beautifully finished pair of matched dueling pistols, while in our own Wild West "Judge Colt" tried outlaws' cases with .45 caliber slugs and riverboat gamblers backed

their bets with deadly little single shot or double-barreled pistols called derringers.

The story of the pistol is like the story of the shoulder gun and its development. When the hand gun, a tiny cannon affixed to a shaft with its end stuck into the ground, represented the latest in firearms, some gunners cut the shaft short and carried it under the left arm. This was the first pistol. During the matchlock period the pistol fared badly; it couldn't be stowed in a pocket or holster because of its sputtering slow match, and without the slow match the pistol couldn't fire.

After the invention of the wheel lock gunsmiths were able to build fairly reliable pistols and many did, especially in Germany, which led the world in mechanical skills in the sixteenth century. Many variations of wheel-lock pistols appeared, some double-barreled or with over-and-under barrels; some were even designed to fire two superimposed charges from the same barrel, using two wheel locks, one ahead of the other. In 1580 a German smith turned out a pair of wheel locks even smaller than the nineteenth-century derringer; they were about two inches long, with a bore of a twelfth of an inch and



FLINTLOCK PISTOL

BLUNDERBUSS

weighed half an ounce each. They were just as deadly.

Many of the early pistols were engraved and carved and their butts and locks were embellished with silver, brass, or ivory inlays and bands. Only the nobles and the

very rich merchants could afford such lavish weapons.

When the snaphance and miquelot locks appeared they too were soon being mounted on pistol frames, but when the simple, reliable flintlock was invented the popularity of the pistol really began. Almost anyone could afford a flintlock pistol and thousands were sold all over the world. Many had rifled barrels and were astonishingly accurate at fairly long ranges. Gunsmiths vied with each other to produce novelties, particularly multishot pistols. Some were simply side-by-side-barrel weapons with two locks; others had four or six barrels that revolved so that each barrel could be locked in firing position in turn. Still others with four barrels had twin locks and flashpans, so that either one or both of the upper two barrels could be fired. Then the cylinder was turned and the lower two barrels were brought into position, ready for two more shots after the pans were again primed. The barrels of many pistols unscrewed so that powder and ball could be loaded from the breech end and a slightly larger ball could be seated in the bore without ramming. The pepper box pistol was the early version of the cylindered revolver in which each shot was fired from a separate, full-length barrel with a separate nipple for a percussion cap at the breech of each barrel.

There were a number of curious multibarreled hand guns like the duck-foot flintlock, the harmonica pistol, and pistols that were combined with knives. These will be discussed in the chapter on firearm oddities.

The blunderbuss, although not exactly a pistol, is much shorter than the musket and falls halfway between the two. Its designers put a bell-mouthed muzzle at the end of the barrel, thinking that its load of musketballs would

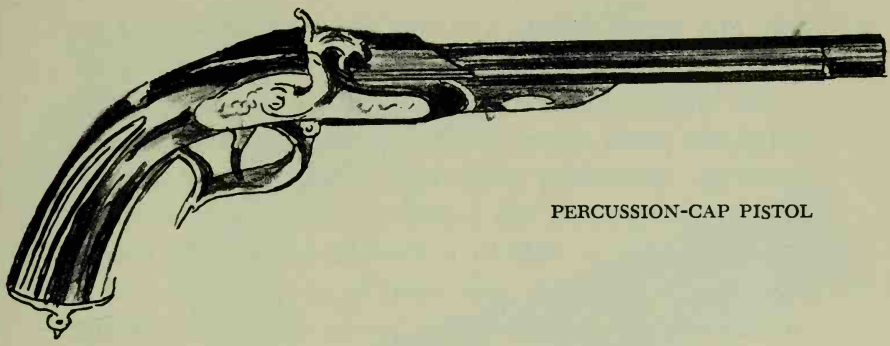
be spread over a larger area. Some of these bell muzzles were enormously wide and others were horizontal ovals intended to distribute the charge along a line of opponents. Actually, the bell mouth had no effect on the shot pattern, which depends only upon the diameter of the bore at the breech, the length of the barrel, and the expansion of the bore.

Two misconceptions about the blunderbuss have been held for generations. One is that the Pilgrim Fathers always carried blunderbusses while hunting wild turkeys for their first Thanksgiving dinner or while on the way to church services on Sunday. The other is that they were loaded with old horseshoe nails, broken glass, pebbles, and scrap iron in addition to lead balls. Actually, the blunderbuss was not in common use in England until some time after the Pilgrims came to America; it was much more likely that the colonists carried matchlocks. As for the unorthodox projectiles, some might have been used during emergencies, but anyone who considered what might happen to gun and shooter if a nail or stone got stuck crosswise in the bore when it was fired would have kept to proper ammunition.

Blunderbusses came in several sizes, from pistols to heavy weapons designed to be fired from a swivel, the latter useful aboard ship to repel boarders, discourage pirates, or overcome mutineers. They were also popular with mail-coach guards and riot police. That horrifyingly wide muzzle behind which lurked a load of 16 buckshot propelled by 100 to 120 grains of black powder was usualy enough to quell any trouble. Captain Ferguson's screw-plug breechlock was also used in pistols late in the eighteenth century.

Another noteworthy weapon was the flintlock *revolver*, invented about 1818. The trouble with all multishot guns that had to be primed with loose powder poured into a flashpan was the constant danger of setting off all the charges at once. This revolver was the first which prevented multiple ignition. Above the cylinder holding the powder and ball was an arm holding a small hollow magazine full of priming powder. When the arm was lowered to the pan, a lever in the magazine turned a rotary valve that dropped a measured quantity of powder into the pan and closed again. When the trigger was pulled the flint struck the frizzen, which was also the front of the magazine, and set off the charge. Then the cylinder was turned to the next chamber and the pan-cover magazine was lowered. This primed the pan again and the gun was ready for the next shot.

The next advance in pistols came when the Reverend Forsyth introduced percussion ignition in 1807, and when the tiny copper percussion cap with its fulminate detonator sealed inside it was invented about ten years later, the pistol manufacturers adopted it eagerly. It was no longer necessary to pour loose powder into a priming pan where a spark might set it off prematurely or a few drops of rain make it misfire. Everything about a percussion lock was so much simpler. With the side flashpan eliminated, the hammer could be placed on top of the pistol instead of on the side; most of its mechanism was concealed inside, and so was less likely to catch on clothing. The bulky vise holding a sharp flint was gone and the hammer now ended in a simple striker that came down on the percussion cap. This was placed on a nipple atop the barrel, and its flame shot down a tiny vent to set off the piece.



PERCUSSION-CAP PISTOL

The new ignition made the revolver a foolproof weapon. Nipples were countersunk behind each chamber of the cylinder, on which the caps were pressed. The cartridges, with the bullet crimped over a paper powder case that was treated with chemicals to make the paper extremely combustible, were loaded from the front of the cylinder and the revolver was ready for action. All revolvers worked on this principle, until the metal cartridge with the enclosed detonator was invented.

Long after the multishot revolver was in general use, one famous single-shot pistol remained popular for years. This was the derringer, built by Henry Deringer, Jr., in Philadelphia, who had long been a maker of fine flintlock rifles and pistols. About 1825 he began making percussion-cap pistols exclusively and then specialized in small, compact, large-caliber pistols that could be carried comfortably in a pocket, waistband, lady's muff, or even a corset. A derringer ranged in length from a tiny 3¾ inches to 9 inches, but its bullets of from .33 to .51 caliber were lethal at short ranges. At a time when every man went armed, especially during the California gold-rush days, the derringer was preferred over all other single-shot pis-

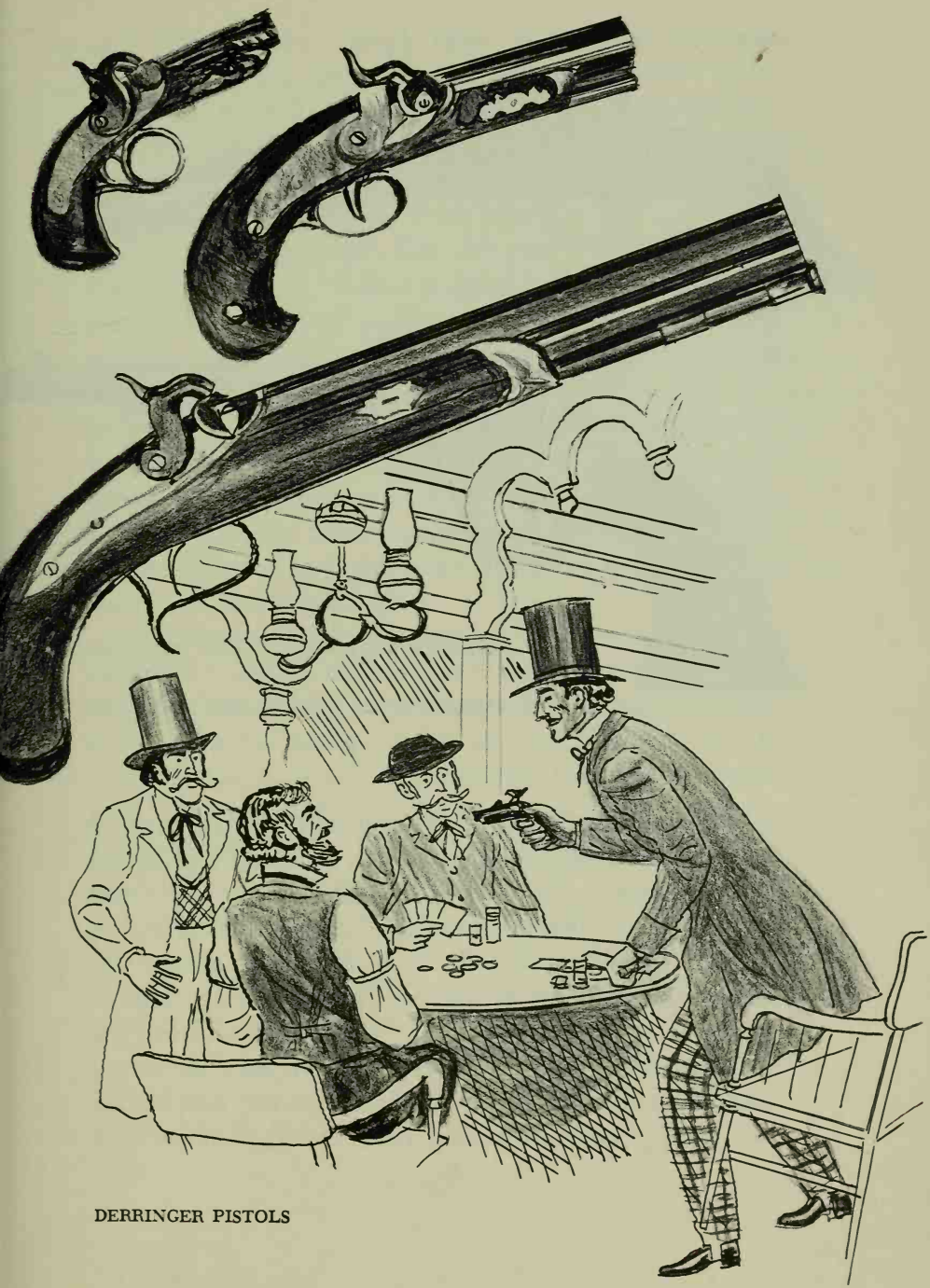
tols, and it was widely imitated; the type was called the derringer even though not made by Henry Deringer.

The final evolution of the revolver, and later of the automatic pistol, came with the invention of the all-metal cartridge, containing inside it a fulminate detonator, the powder charge, and the bullet. The first successful cartridge, invented in 1846 by a Frenchman, was the *pin-fire* cartridge. A small pin protruded from its side and came up through a hole in the gun's breech when the cartridge was loaded. When the pin was struck by the hammer it in turn hit a small percussion cap inside the other wall of the cartridge and set off the charge. However, pin-fire cartridges were easily damaged, they exploded easily in handling, and the vent from which the pin projected allowed moisture to enter the barrel. Still, this and all succeeding all-metal cartridges had one advantage in common: their cases expanded from the heat and pressure of firing, which sealed the breech completely against gas leakage.

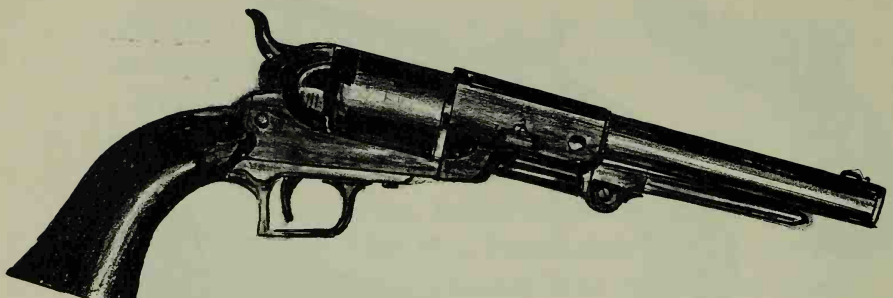
During the next few years there were two further improvements. First came the *rim-fire* cartridge with the fulminate in a tiny channel running all around the edge of its base. This eliminated the need for a pin; no matter how it was put into the breech the hammer would detonate the fulminate ring. The final version, still used today, was the *center-fire* cartridge, with the percussion cap placed in the center of the base where it was struck by a sharp firing pin on the hammer.

The new cartridges spurred the gunsmiths on to building better *six-shooters* during the 1860's and '70's, a time when many names like Colt, Smith & Wesson, Remington, Adams, and Savage became famous.

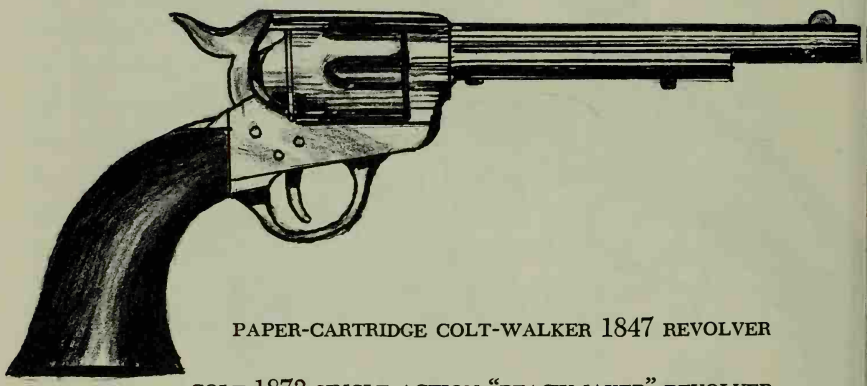
Samuel Colt's revolvers were probably the best known



DERRINGER PISTOLS



PAPER-CARTRIDGE COLT-WALKER 1847 REVOLVER



COLT 1873 SINGLE-ACTION "PEACEMAKER" REVOLVER

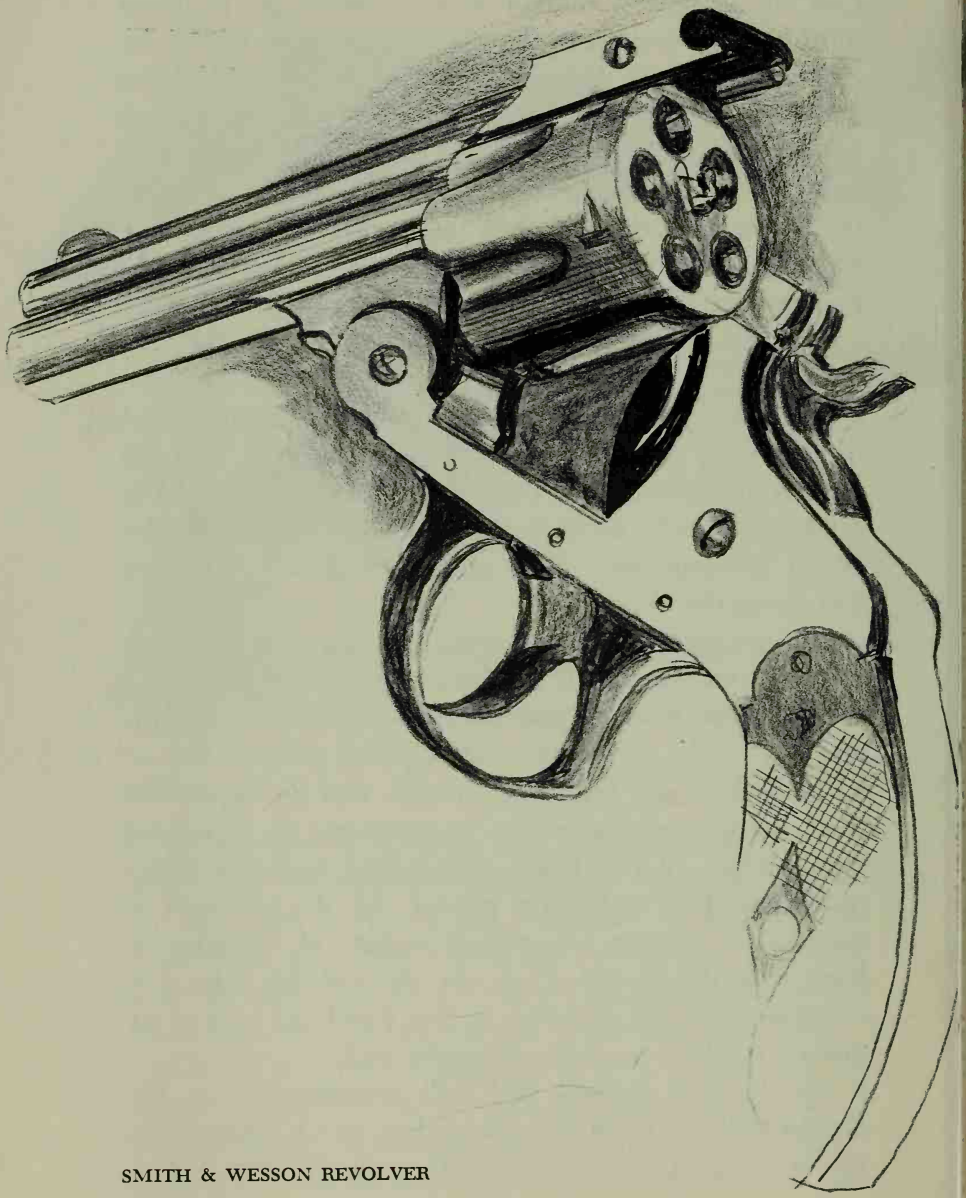
of all revolvers ever made, and he was first to invent a practical revolving-barrel hand gun. It is said that he got his idea from watching the helmsman on a ship while cruising on the Indian Ocean. He noticed that no matter how the wheel was turned, one of the spokes always was lined up with a clutch that the helmsman could lock.

Colt mulled over the idea and in 1830 whittled out the first crude model of his revolver. Six years later he started manufacturing the weapon. The Colt worked well but no large order was forthcoming from the government and

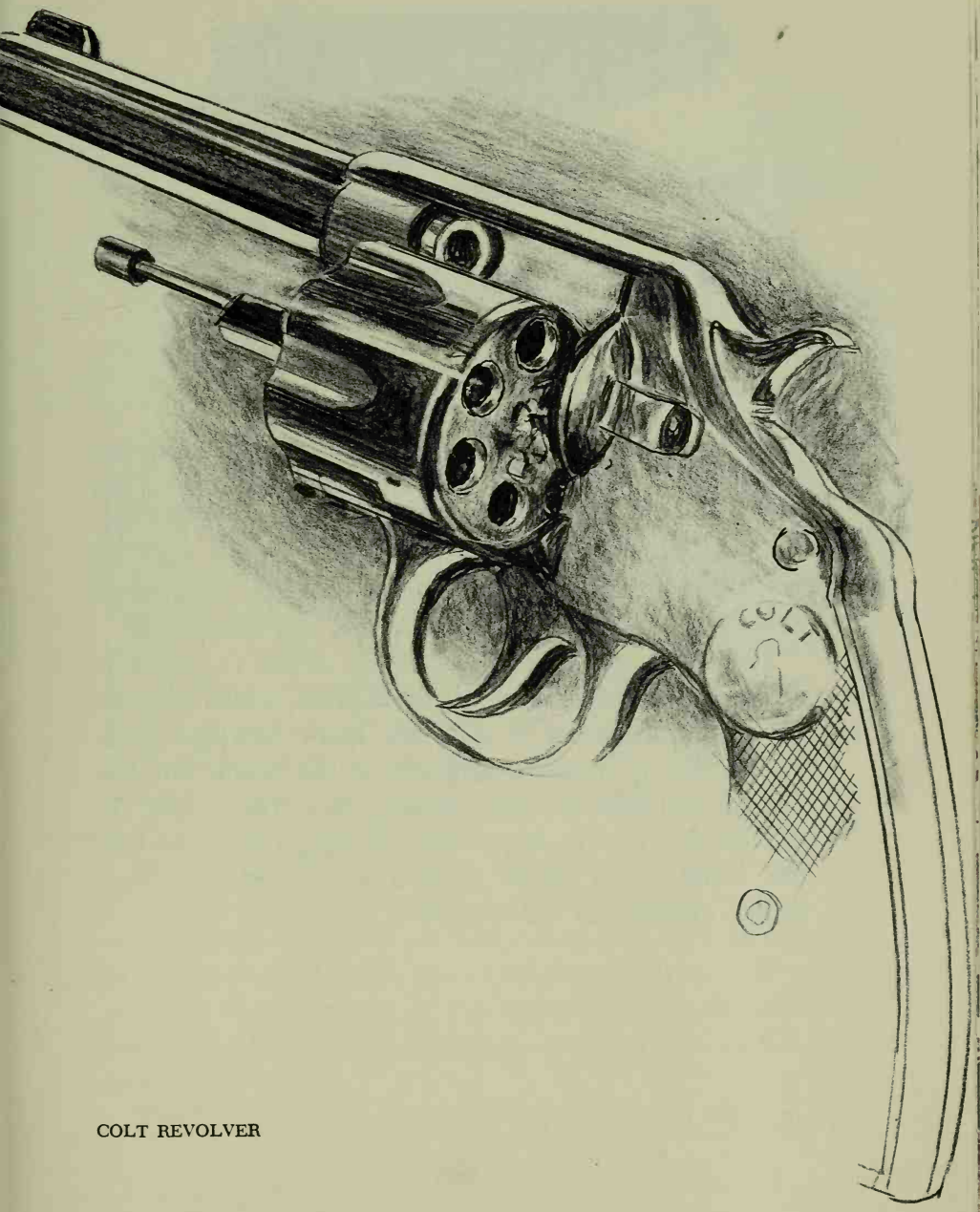
Colt did not have enough time or money to continue until his gun was accepted, and his company had to be liquidated in 1847. Meanwhile his guns had reached the Far West where the sheriffs, rangers, and Indian fighters liked them and wanted more. When Colt enthusiasts among the Texas Rangers in the Mexican War finally convinced Army Ordnance that the gun was a good one, Captain Samuel H. Walker was sent to find Colt and help him get his company started again. Walker also helped redesign the revolver and the Walker-Colt of 1847 became the first revolver to be issued to troops. The discovery of gold in California that brought heavy migrations to the West, and the Crimean War in Europe, brought success to Colt's firearm company, which led the field in producing sturdy, accurate firearms, including the single-action "Peacemaker," the most famous of the hand guns that "won the West."

The revolver, with its rotating cylinder that held five or six cartridges and fired them one by one through a single barrel, was so superior, even as a percussion-cap weapon, to the earlier pepperbox pistol, with its five or six badly balanced full-length barrels, that the pepperbox soon disappeared. Gunsmiths concentrated on improving the revolver. In the 1830's they added a double-action mechanism that cocked the hammer for the next shot as soon as the trigger was pulled, instead of "fanning" it back with the thumb. They also devised the automatic ejection of a spent cartridge so that it did not have to be pushed out by hand with an ejector rod.

The loading method was still cumbersome, as the shooter still had to push the cartridges into a loading gate in the breech one at a time as the cylinder was turned.



SMITH & WESSON REVOLVER



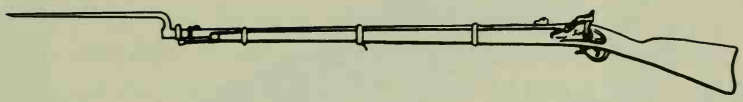
COLT REVOLVER

WALTHER AUTOMATIC PISTOL

Then two different methods of quick loading were developed. In one, the gun broke open on a swivel, tipping the barrel forward and exposing all the chambers of the cylinder, as with the Smith & Wesson; in the other, the Colt method, the gun's hinged cylinder could be released to drop out at the side when a releasing rod was pulled.

The latest step in the development of the hand gun is the *automatic pistol,* such as the Walther, which uses the gas of the explosion to eject the spent cartridge, push a fresh one up from the magazine in the handle into the breech, and cock the gun automatically. The bullets are in clips that can be slipped into the magazine in the hollow handle from below much more quickly than they can be loaded into the cylinder of a revolver.

9 Firearms in America



Weapons on the Battlefield

The smoothbore large caliber short-range musket may have been the most efficient arm in battles between troops trained in conventional European battle tactics and against the charges of primitive natives, but it was far from the ideal weapon when British troops carried it into battle in America during the Revolution in 1776. Here the fighting was often carried on in thick woods or muddy swamps, or from rocky cliffs. The American colonists used Indian tactics: they fired from behind trees and rocks, picked off the advancing grenadiers, and then melted into the underbrush.

Most of the early American colonists were poor when they emigrated from England in the seventeenth century, and although wheel-lock and snaphance guns were already in use they were much too expensive and were seldom seen. By the beginning of the eighteenth century, however, every farmer and woodsman owned a reliable flintlock musket or rifle.

The best American troops in the Revolution were the

backwoods frontiersmen dressed in greasy fringed buckskins. These skilled woodsmen were crack shots, and each one was armed with the finest shooting iron available in those days. This was the so-called Kentucky rifle (it should have been called the Pennsylvania rifle after the place where it was made) inspired by the rifles brought to America by German immigrants.

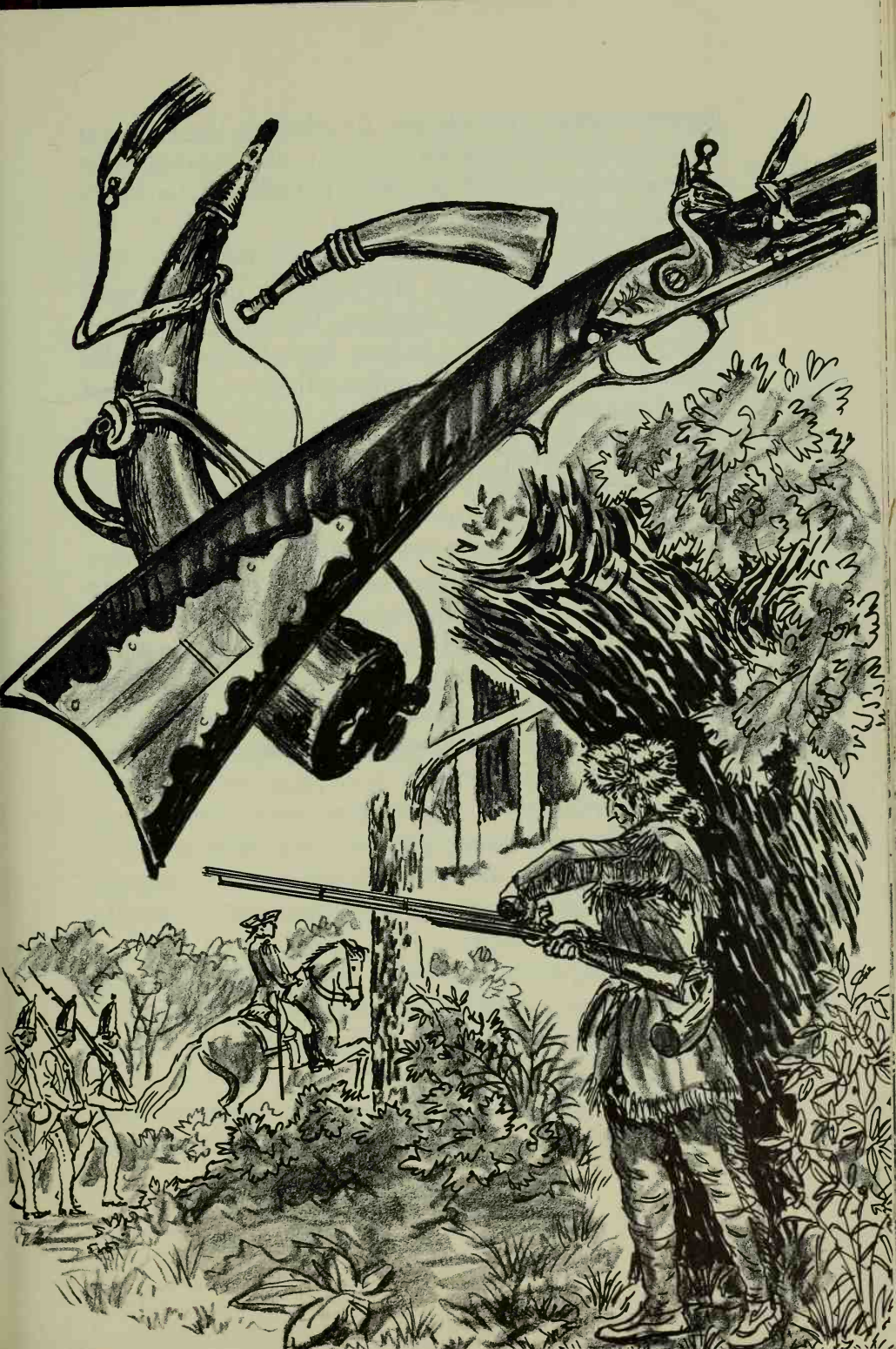
The Kentucky rifle was a small caliber, rifled flintlock with a long barrel and was so deadly accurate that a good shot could hit a squirrel in the eye at two hundred yards. The British regulars in their scarlet jackets and white crossbelts were sitting ducks to the Americans, whose Kentucky rifles outranged the English Brown Bess musket four or five times.

The slaughter of their regulars was so great that the British, in desperation, imported German mercenaries, hunters, and gamekeepers from the wild Bavarian mountains, also armed with rifles to combat the lethal American marksmen. The German mercenaries, sold by their king to the British, were not very enthusiastic fighters. Who could blame them?

Only when the troops met on level ground where the British could fire heavy volleys at close range and follow with the bayonet did they triumph over the colonists. Here the Kentucky rifle was at a disadvantage, because its tight-fitting bullet was slower to load and because it had no bayonet.

After the Revolution the pressure of immigration drove new settlers westward into the forests of Ohio and Kentucky to establish homesteads. The frontiersman's most

KENTUCKY RIFLE—POWDER HORN AND PRIMING POWDER HORN



important tools were his axe, for clearing the land and building his cabin, and his Kentucky rifle to bring down game for his table and to defend himself and his family against marauding Indians.

By the mid-nineteenth century, settlements and farms had sprung up across the Mississippi on the new lands opened by the Louisiana Purchase. The long rifles played their part in driving the Indians from hunting grounds ceded to them by treaty and drove them ever westward to the Great Plains.

The Civil War was the first "modern" war, in which railroads, ironclad gunboats, the telegraph, canned food, and even balloons were used in military campaigns. Especially in weaponry, there were numerous breakthroughs; inventions were used that had never been tried out before in battle. Since neither side was prepared for such a conflict, the troops at the beginning were armed with a conglomeration of weapons ranging from old flintlock smoothbores dating from the Revolution, hunting rifles, and even shotguns to the most modern inventions of the nineteenth-century gunmaker.

Rifled barrels, breech loading, percussion caps, expanding cartridges, and repeating-magazine rifles were already in existence, but the ultraconservative military mind almost always rejected new ideas until desperate need forced their adoption.

A telling argument in favor of the breech-loading rifle was provided in a report from the chief of the Bureau of Ordnance, Navy Department, in November 1864.

> The official report of the examination of the arms collected upon the battle-field of Gettysburg, states that "Of the whole

number received, 27,574, we found at least 24,000 of these loaded; about one-half of these contained two loads each, one-fourth from three to ten loads each, and the balance one load each. In many of these guns from two to six balls have been found, with only one charge of powder. In some, the balls have been found at the bottom of the bore with the charge of powder on top of the ball. In some as many as six paper regulation caliber '58 cartridges have been found, the cartridges having been put in the guns without being torn or broken (preventing them from being exploded by the percussion cap). Twenty-three loads were found in one Springfield rifle-musket, each loaded in regular order. Twenty-two balls and 62 buckshot with a corresponding quantity of powder, all mixed up together, were found in one percussion smooth-bore musket.

This proved vividly that in the roar and confusion of battle a large proportion of the men excitedly forgot to pull the trigger during the attack, their guns missed fire, or they loaded them improperly. Their guns were, therefore, useless and if the overloaded ones had fired, the guns would have exploded, killing the soldier and his mates. With a breechloader such mistakes could not have occurred.

The famous Sharps rifle made its debut in time to see action during the Civil War. Designed by Christian Sharps, who had worked at the Harpers Ferry gunworks and who later built the widely used .45 caliber buffalo gun, this rifle, patented in 1848, had a breechblock that was lowered by a trigger guard lever to insert a paper cartridge. When the block was raised a knife edge cut open the paper cartridge to expose the powder to the flame of a percussion cap. Later the Sharps was adapted to metallic cartridges.

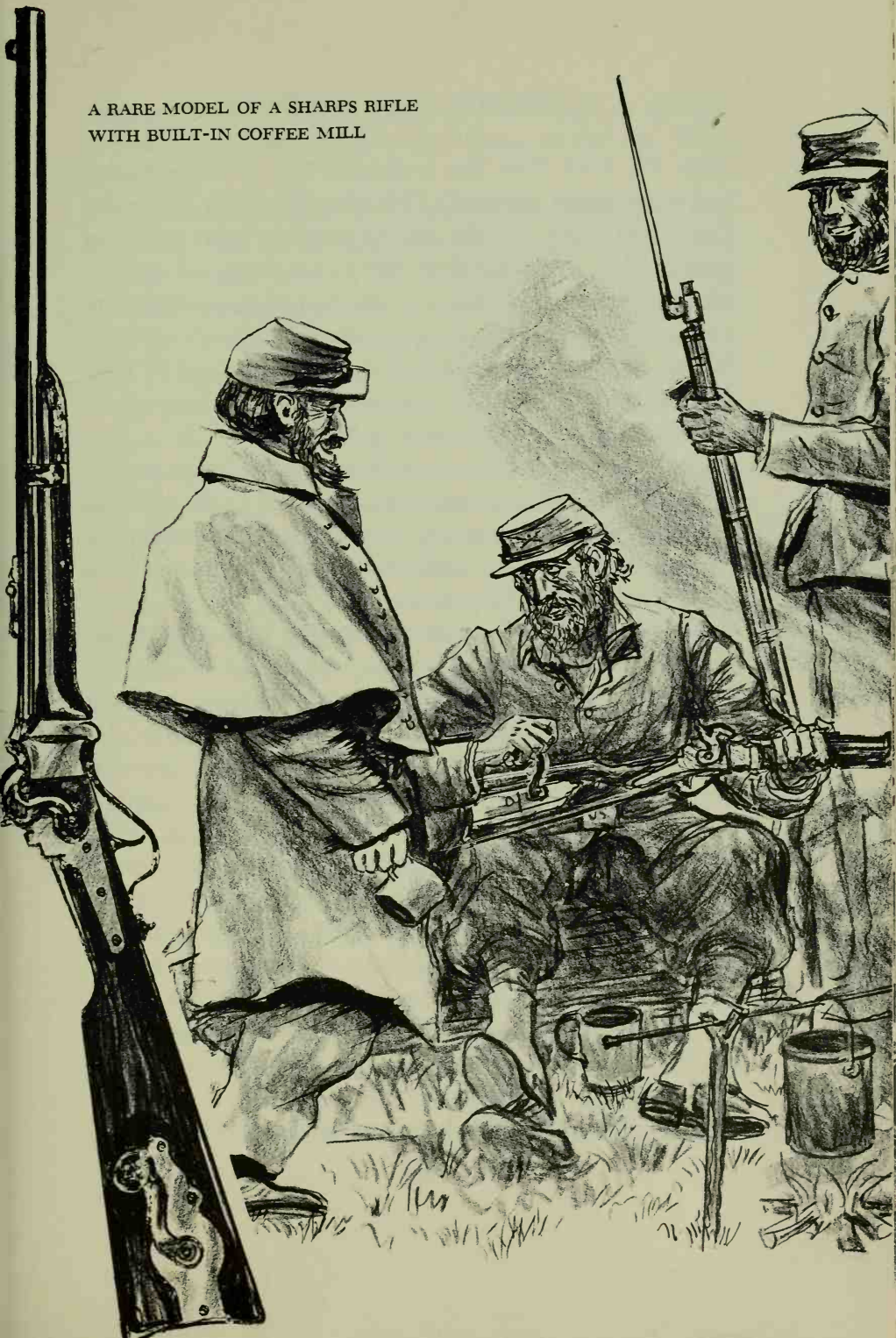
Thousands of Sharps were purchased for the Union Army, and a regiment of marksmen under Colonel Hiram Berdan equipped with Sharps were such deadly riflemen that they deserved to be called "sharpshooters." The guns were built both as long rifles and shorter cavalry carbines. One rare model even had a coffee mill built into its butt to grind corn and grain foraged from the farms, as well as the issue coffee beans!

In the North, steel mills, gun factories, and powder mills worked overtime turning out breech-loading rifles, carbines, and ammunition. Flintlock muskets were converted into percussion-cap weapons. Repeating rifles, sixteen-shot Henrys, and seven-shot Spencers, firing brass-capped paper, all-brass, or copper cartridges containing charge, bullet, and cap, were being issued in increasing numbers.

For single-shot weapons, the paper-wrapped cartridge, containing a measured charge of powder and sometimes also the ball, could be rammed down the barrel or slipped into the breech in one motion. The gunner did not have to pour powder out of a horn, wrap a bullet in a greased patch, which spread and engaged the rifling, and then ram it down hard and prime the pan.

Both the North and the South purchased large quantities of guns and ammunition abroad. The southern weapons were smuggled in on fast blockade runners at great risk and expense, but the South's need for supplies was desperate since there was little manufacturing there. Southern troops were supplied with arms taken over from United States arsenals in the South, captured northern weapons, and what their government could import or make themselves.

A RARE MODEL OF A SHARPS RIFLE
WITH BUILT-IN COFFEE MILL



After the Civil War the westward trek of homeseekers and adventurers resumed. Following the trails blazed by Lewis and Clark in 1804 and Frémont in 1843, trains of prairie schooners jolted their dusty way westward, searching for homesteads. Their drivers had been preceded by the mountain men who trapped beaver in the icy streams, by the emigrants who reached the promised land of Oregon in the 1840's and by the forty-niners pushing across the Rockies to the California gold fields.

Great herds of longhorn cattle raised on Texas ranches were being driven overland northeastward to the railhead in Kansas and eastern markets by tough riders headed by tougher trail bosses. In 1866 two railroads began a race to build tracks across the continent.

In all this vast lonely land stretching from the Mississippi to the Sierra Nevada there was almost no law enforcement; each man was expected to protect his own rights and defend himself from desperadoes, army deserters, "road agents," cattle thieves, and claim jumpers as well as drunken cow punchers with itchy trigger fingers. It was a time when history was made by hot lead. Rifles by famous names like Winchester, Spencer, Henry, Remington and Sharps defended home and property—or appropriated them. The famous Colt .45 "Peacemaker" revolver and the equally famous single-shot derringer rode in every man's belt or pocket. They decided differences of opinion and meted out instant punishment for the lawbreakers or saw evil triumph, depending on whose trigger finger was quicker.

While the miners, ranchers, and gold seekers lately ar-

rived in the West began building a new kind of civilization on the frontier, most of the West was still the "Wild West."

Vast herds of buffalo once roamed the entire American continent, but by the mid-nineteenth century they had become extinct east of the Mississippi. On the Great Plains, however, they grazed in uncounted millions in herds so large that they extended to the horizon, supplying a good living for the Indians and the great gray wolves.

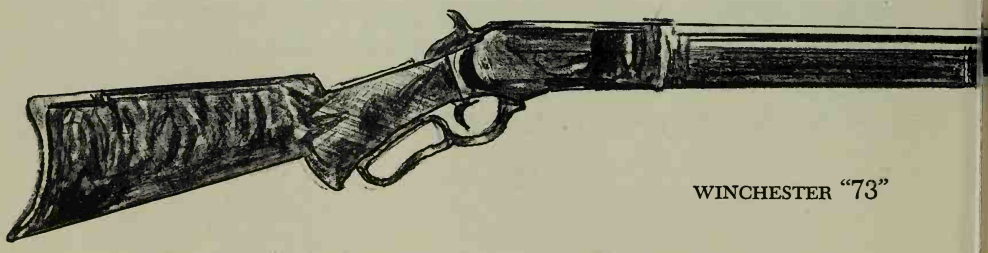
The wolves and Indians never killed enough buffalo to deplete the herds, but the white hunter, who now appeared in the West, was usually armed with the buffalo gun, the Sharps rifle, a .45 caliber heavy-barrel weapon loaded with a charge of 120 grains of black powder and a 550-grain bullet. Most of these men were commercial hunters interested only in the hides, which brought a good price in the east as harness leather and as fur coats and lap robes for driving in sleighs in winter. They each killed from one hundred to three hundred a day, skinned them, carved a few choice slices of tongue, liver, or hump for their dinners, and left the skinned carcasses to rot in such numbers that for miles the air stank.

The best known of the professional hunters was Buffalo Bill (William F. Cody). A Pony Express rider and a Union scout for the 9th Kansas Cavalry in a campaign against the Kiowa and Comanche Indians, and later for the army in Tennessee and Kentucky military operations during the Civil War, he was later hired as a buffalo hunter to provide meat for railroad construction gangs. He claimed to have killed 4,280 buffalo during a seventeen-month period with his .50-caliber breech-loading rifle. A series of dime novels made the name Buffalo Bill as well known as that

of Sandy Koufax today, and later he proved himself a superb showman with the Wild West show that made him a fortune.

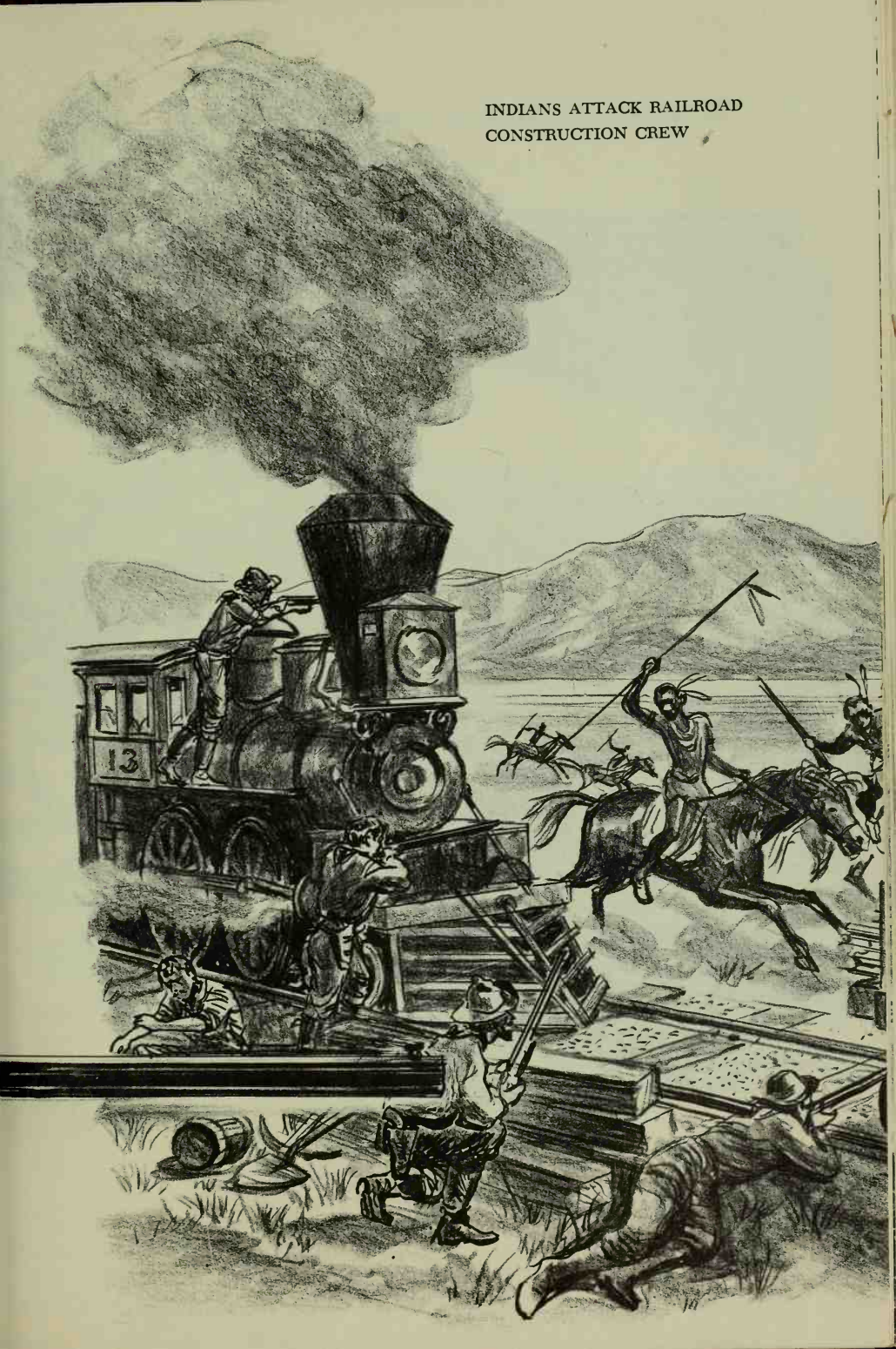
Amateur sportsmen also went on bufflalo hunts, the most spectacular being a wealthy English eccentric, Sir George Gore, who spent half a million dollars on a three-year safari and butchered the bison by having the herd driven toward the gun he had set up on a tripod. In one day's shooting he is reported to have destroyed a thousand buffalo, selecting only the finest heads and hides for mounting and curing, and leaving the rest where they fell. He tested a hundred guns and decided that the heavy .45 Sharps was the best all-around buffalo gun.

In the years before 1883 commercial hunters killed an estimated twenty million buffalo and some years shipped a half million hides to the East, almost wiping the species out. This upset the economy of the Plains Indians. The nomadic "horse" Indians—Comanches, Cheyennes, Sioux, and Apaches—who rode the descendants of the horses the Spaniards left behind in the seventeenth century and were armed with bows and lances, lived off the buffalo. He was the Indians' general store; they ate some of the meat while it was fresh and jerked (cut into strips and dried) the remainder for later use. They used the hide for leather to make their clothes and moccasins as well as using it

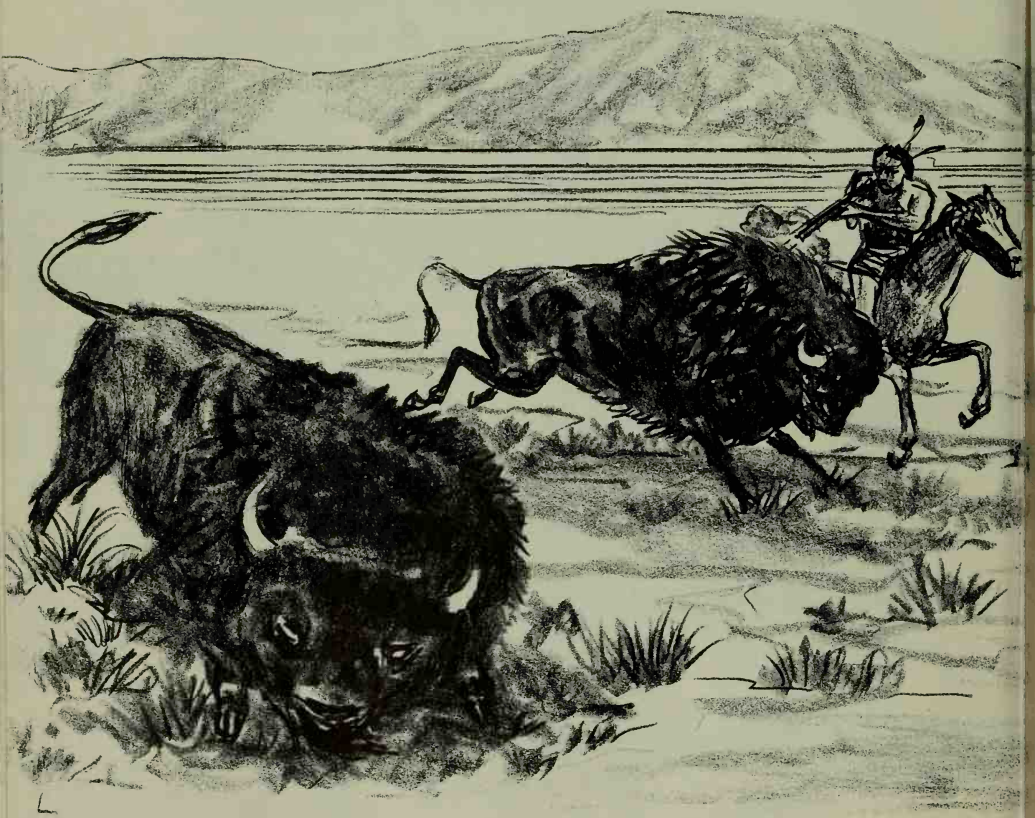


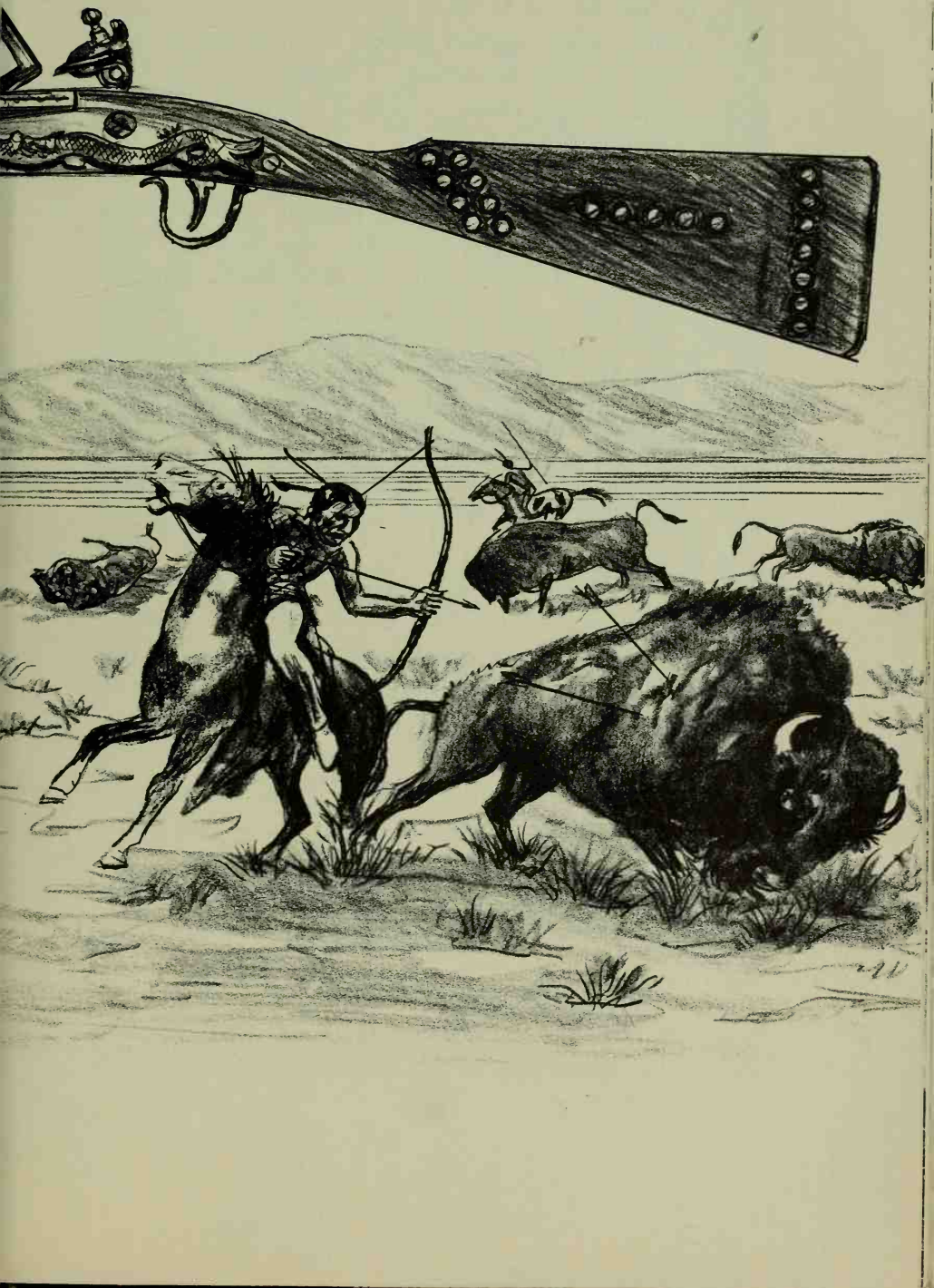
WINCHESTER "73"

INDIANS ATTACK RAILROAD
CONSTRUCTION CREW



INDIAN-TRADE MUSKET WITH BRASS SNAKE SIDE PLATE





with the hair left on to make warm robes and blankets. Several hides sewn together formed a tepee and strips of it were used to make bowstrings or lacing. Even the dried dung, called "buffalo chips," supplied fuel for the cooking fires in a land with few trees.

Now the white man's rails were pushing west through the heart of the Indians' hunting ground. The pick-and-shovel men and track layers were kept supplied with meat by the hunters; all day long the crack of the Winchester, Sharps, and Remington was heard, while silent red-skinned figures on scrawny ponies watched from a knoll far out on the prairie. The dismay of the Indians grew as they saw their hunting grounds despoiled, the game growing scarce, and starvation threatening. At last they declared war and began raiding lonely ranches, stagecoach stations, and construction camps. They attacked railroad gangs and even derailed and burned trains.

Squads of soldiers were sent to guard the camps and the right of way; each mile of track laid was paid for in blood. Every laborer and teamster kept his Winchester within reach. Without these rifles the transcontinental railroads might have been delayed for years.

As usual in such wars, farmers and ranchers and their wives and children suffered from the raids, and soon the government was petitioned to supply protection. Small commands of infantry and cavalry were stationed at a string of posts and forts built throughout the West to watch the tribes, try to pacify them, and protect the settlers.

From the early nineteenth century until well into the twentieth the War Department built 290 forts, arsenals, and military posts west of the Mississippi. Many of these

were soon abandoned, however, and they were never all in commission at one time. After the Civil War military funds were drastically cut and most of the western posts were undermanned for the work they were expected to do, meagerly supplied, and sometimes poorly commanded at the very time the Indians were most belligerent.

Some detachments were still armed with single-shot muzzle-loading Civil War muskets while the Indians sometimes had repeating rifles. The redskins usually got their weapons from the white traders who constantly visited their camps, trading their stocks of blankets, kettles, beads, illicit whiskey, and, especially, guns for furs and horses.

For many years gun makers in both Europe and America turned out special smoothbore muzzle-loading muskets called *trade guns,* to be sold to the Indians. They were generally not as carefully made and finished as standard weapons and some were so bad that they soon burst or wore out. In the early days, the Indians preferred flintlocks to percussion-cap guns since flints could be picked off the ground and caps were expensive. The first trade guns were distinguished by deep trigger guards, a decoration on the butt stock in the shape of a brass serpent, and often brass studs on the stocks; later the Indians insisted on these characteristics on any gun they bought. As time went on, better weapons—even repeaters—were sometimes obtained from illegal traders at high prices or were stolen or captured during raids.

The government remained reluctant to buy new breechloaders while the armories were still stocked with thousands of good muzzle-loading Civil War Springfield rifles, so it was decided to find some way of modernizing them. A master armorer named Erskine Allin at the Springfield

armory worked out a movable breechblock by which the Springfield could be converted into a breechloader. Because the breechblock was hinged to flip open forward, it was called the "trapdoor" Springfield. Although only a single-shot, it was a good weapon and became the standard arm for the troops throughout the thirty-odd years of the Indian wars. Some detachments managed to obtain repeating Winchester, Spencer, and Henry rifles, and soldiers so armed gave a good account of themselves against the redskins, who also had some repeaters but who were never good shots.

While Fort Philip Kearney in Nebraska was under construction it was the scene of a bloody massacre of troopers guarding a lumber convoy in December 1866. Because the troopers had only single-shot rifles they were overrun by a vastly superior number of Sioux.

The next August, after more than six months of quiet at Fort Kearney, the Indians attacked another wagon train under Major Powell, an experienced Civil War veteran. The wagons, their boxes bullet-proofed with sheet-iron lining, were drawn into the typical prairie schooner defense circle, and the thirty men of the detachment prepared to fend off the tribesmen from within the wagons.

The opening attack was launched by a whooping, howling band of eight hundred painted braves who galloped wildly down on the wagons, expecting to crash into the circle when the troops had to reload. Instead they were met by such a hail of bullets that those who were not killed broke and fled. Then an even larger mass of warriors; twelve hundred of them, thundered down from the hills only to meet such hot fire that their charge was also broken up. For three hours the Sioux hurled attack after

attack against the platoon of soldiers only to be mowed down. When they finally gave up they left hundreds dead on the field, while only one trooper was killed and two wounded. The Indians were convinced that some mysterious strong "medicine" protected the whites—which was true: the soldiers were armed with repeating rifles.

Ten years later the tables were turned again. On June 25, 1876, Lieutenant-Colonel George A. Custer rode into what is now Montana at the head of several troops of the 7th Cavalry, which he split into three groups, to hunt Sitting Bull and his Sioux and Cheyennes. His scouts reported a small group of Indians at the juncture of the Big Horn and Little Big Horn rivers, and Custer, commanding one group, moved forward to attack them. Suddenly, overwhelming masses of braves appeared from the ravines in which they had been hiding and swept down on Custer's column. The Indian victory this time was complete; Custer and all his men (more than two hundred) were slaughtered. The only description we have of the battle came later from the Indians who had been in it.

Some believe that Gatling guns might have prevented this debacle or that repeating rifles might have won out, but most evidence indicates that the attack was so swift that the pack animals loaded with ammunition were stampeded immediately and Custer's men were left with nothing but the cartridges in their belts. Although the Indians had taken the rifles, investigators found many clipped-off cartridge cases alongside troopers' pocketknives, indicating that the soft copper cartridge cases issued at that time had expanded in the breeches and could not be withdrawn without being pried out.

Some military experts believe Custer's men were so far

outnumbered that nothing less than several breech-loading field-pieces would have saved them. Bullets didn't scare the Plains Indians but explosive shells panicked them, and roving columns of troops often carried mountain-pack artillery for this reason. The last of the rebellious Indians were finally subdued at Wounded Knee in 1890 and herded to reservations by troopers armed with repeating rifles.

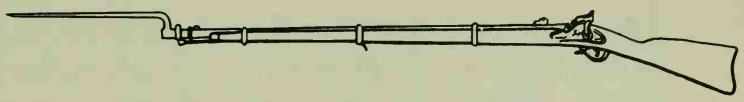
Firearms also brought enormous changes to the wildlife of America. Lewis and Clark, in their famous exploring expedition to the Pacific, were constantly awed by the superabundance of every sort of animal and bird in the wild country they traversed. They told of seeing great herds of buffalo, antelope, and elk grazing in the meadows, shadowed by packs of fierce gray wolves. Bighorn sheep, deer, caribou, and moose left their tracks in the forest and swamps and among the crags. Beaver dams choked every stream and the underbrush swarmed with rabbits, porcupines, and foxes, which were preyed upon by lynx and panther. Great numbers of black and grizzly bears rooted among the berry bushes and every lake and pond held flocks of geese, ducks, and wild swans, while the upland meadows swarmed with quail, partridge, and wild turkeys.

In a little more than a hundred years most of this game was gone, victims of an expanding population and of the market hunters' rifles and scatter guns. The market hunters built weapons much like the ancient organ guns; they had numerous barrels and fired fusillades of shot into the flight patterns of migrating birds, bringing them down by the thousand. Then the birds were sold for a few pennies each.

The beautiful passenger pigeons that once flew in such enormous flocks that they darkened the sun were so mercilessly slaughtered that the species was wiped out; the last living specimen died in captivity in 1914.

By the twentieth century most of the wild game was gone and hunters were required to take out licenses that specified a limited bag during a short season as a protective measure. The firearm has had the same effect on game all over the world. Even Africa, which not so long ago teemed with uncounted numbers of zebra, antelope, giraffe, lions, and elephants, has seen such a drastic reduction of game that animal preserves have had to be established.

10 Modern Weapons



Although the first steps toward mechanizing warfare were taken during the American Civil War, on the European continent cavalry charges reached their peak during the Napoleonic wars in the first half of the nineteenth century. They were used to panic and roll back infantry lines and they often decided the course of a battle. But when foot soldiers acquired the percussion-cap, and later the breech-loading, rifle, and still later the machine gun, the casualties to a charging line of horsemen became so great that the frontal charge was abandoned and the cavalry was limited to scouting and raiding.

In the middle of the eighteenth century the British East India Company, known then as the John Company, which had its own private army and fleet, gained control of India. The nineteenth century saw the expansion of empire, especially on the African continent, by the major European nations—Britain, France, Portugal, Belgium, Italy, and Germany. Their new colonies were conquered by various methods, sometimes diplomatic but more often by "gunboat diplomacy." The threat presented by the appearance of a warship bristling with modern guns and

capable of landing a well-armed expedition was usually enough to quell any resistance on the part of native populations.

Occasionally there were unexpected repercussions. In 1857 the new paper cartridge used in the muzzle-loading guns issued to Indian troops recruited by the East India Company was considered partly responsible for the bloody Sepoy Rebellion. Brahmin sepoys, to whom the cow is sacred, believed that the paper cartridges (the ends of which had to be bitten off so the powder could be ignited) had been greased with beef fat, while the Mohammedan sepoys, to whom pork was forbidden, thought that lard had been used. Both felt that such an insult to their religions was not to be borne.

In Europe itself, the Crimean War and the Franco-Prussian War of 1870–71 were the last large conflicts fought on the continent without the modern weapons: machine guns, planes, and tanks. The Crimean War saw the introduction of the Paixhan cannon, which fired an explosive shell. Using such shells the Russians annihilated the Turkish wooden-walled fleet at Sinope in 1853, convincing even the diehards that ironclad warships and shell-firing guns had to be reckoned with.

In 1870 the French Chassepot rifle and the German Dreyse "needle-gun" (so called because the hammer drove a sharp steel point into a percussion cap in the middle of a cartridge) confronted each other; but the balance of power lay with the Prussian cast-steel breech-loading field-piece, which outperformed the French bronze muzzle-loader.

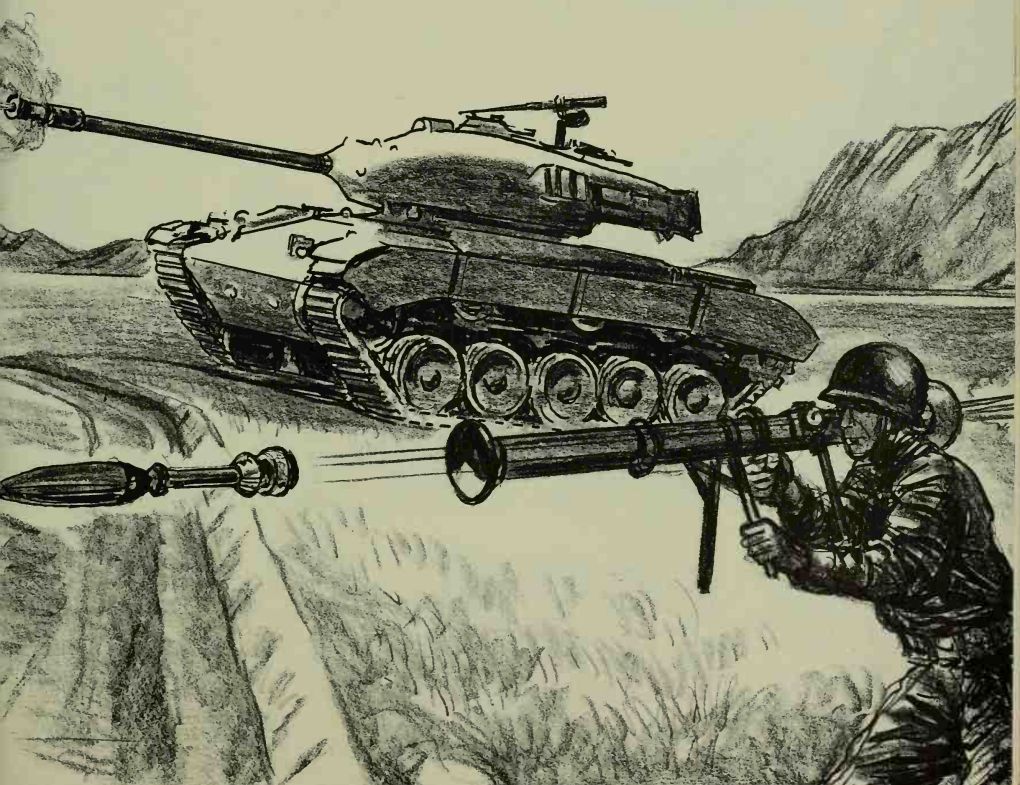
By 1900 the world's armies had the benefit of breech-loading magazine rifles, machine guns, and modern siege and field guns. Battlefields would no longer be hidden

under dense clouds of smoke from black powder; smokeless powder now superseded it. France already had the famous 75-millimeter light field gun and the Germans the Maxim machine gun when the storm clouds gathered and the opening roar of the guns of 1914 was heard around the world.

Huge German siege guns were able to batter the Belgian border forts to rubble in a few days and open the way into France for the Prussian divisions. Desperate French resistance and a shortage of supplies halted that first rush. The conflict turned into four years of trench warfare in which thousands of lives were sacrificed to gain a few yards of blood-soaked ground.

1951 WALKER BULLDOG 25.4-TON LIGHT RECONNAISANCE TANK

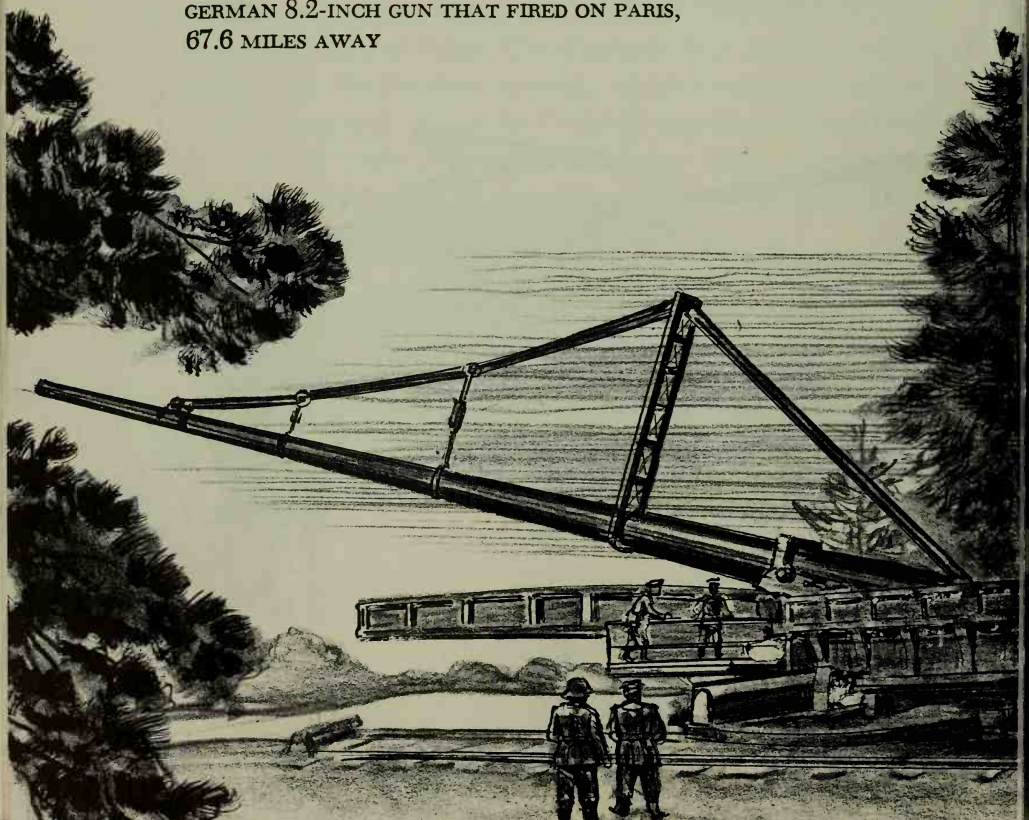
35-INCH BAZOOKA WORLD WAR II



The range of artillery has constantly increased through the years, but one gun built by the Germans to shell Paris far outstripped any other. It was made from a 15-inch naval gun, but was lengthened and had an inner tube which reduced it to a caliber of 8.26 inches. It was first fired on March 23, 1918, and dropped its 228-pound-shells on Paris, 67.6 miles away, for some months, but it was a freak weapon that required enormous preparation and its barrel wore out after only a few shots.

Only a few new weapons and defenses were introduced in this war. Barbed wire, deep trenches, and heavy concentrations of artillery, machine guns, and mines had all been used before. Only five weapons emerged as important in World War I and caused radical tactical changes:

GERMAN 8.2-INCH GUN THAT FIRED ON PARIS, 67.6 MILES AWAY



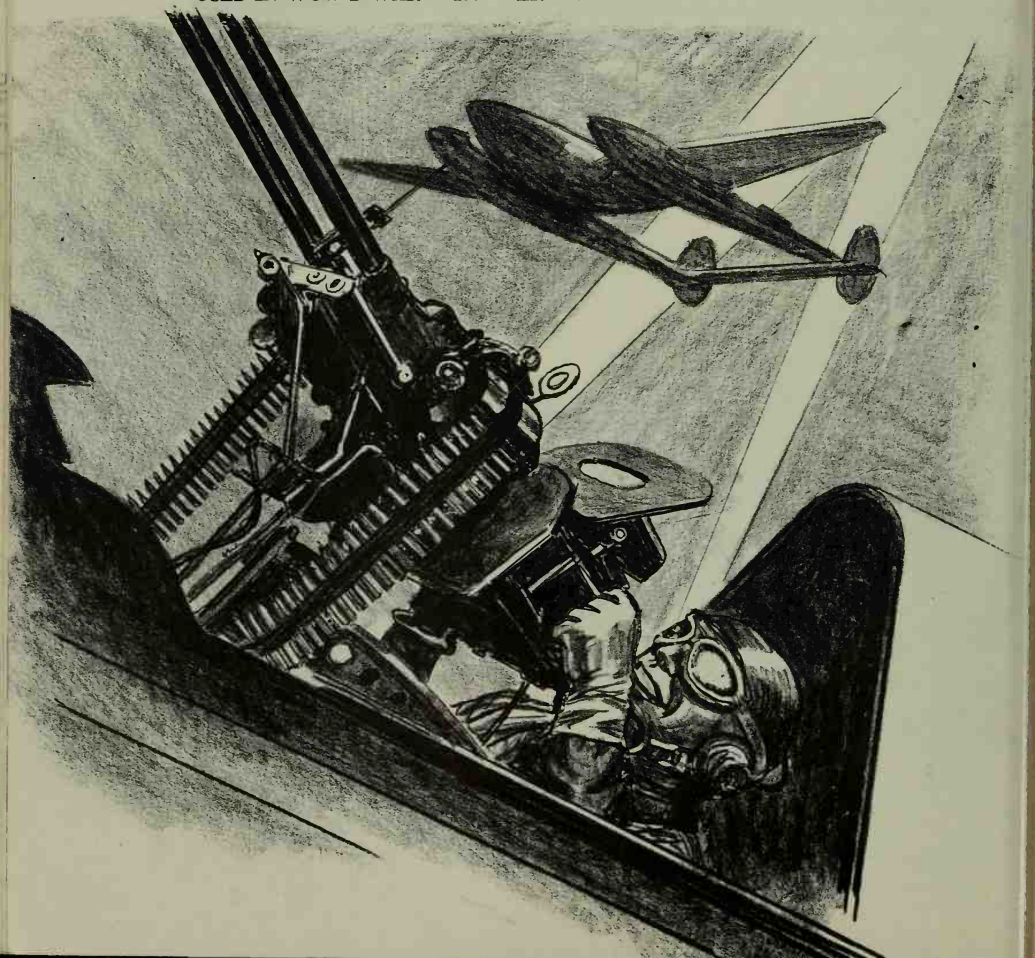
poison gas, the tank, the submarine, the trench mortar, and the airplane.

The tank was one of the few brand-new military weapons of World War I. The first one was invented by the British; it was a huge clumsy vehicle with caterpillar treads, but its principle—an armored body sheltering a gun and its crew that could cross almost any kind of ground—was sound. It was the forerunner of many models designed for different purposes and was constantly improved during World Wars I and II, in Korea and now in Vietnam. Pictured is the M-41, the Walker Bulldog Light Tank, 18 feet 4 inches long, weighing 25.4 tons. It is armed with a 76.2-millimeter gun and has a speed of 40 miles per hour with a 500-horsepower engine and a crew

of four. In operation since 1951, it can be transported by air and used for reconnaissance work.

At the beginning of World War I the airplane was in its infancy. When Louis Blériot managed to cross the English Channel on July 25, 1909, imaginations leaped at the possibilities of flying, but no one had envisaged the plane as a war machine. In 1914 the airplane was a light wood-framed "kite" with cloth-covered wings and was braced with piano wire. Its low-powered gasoline engine was capable of pushing the craft only at 40 or 50 miles an hour.

TWO .30 CAL. MACHINE GUNS ON SINGLE MOUNT
USED IN WORLD WAR II TRAINER PLANE



The plane was first used for reconnaissance, and when enemy pilots encountered each other, they exchanged pot shots with shotguns and revolvers. Presently German Taubes and Fokkers, biplanes and triplanes, met the allied Nieuports, Spads, and Camels in aerial combat with machine guns of various types, .30 caliber weapons, firing from above the upper wing or through the synchronized propeller.

Larger planes were built for bombing, and military men soon began perfecting that most devastating method of modern destruction, the bombing raid. The United States Air Force has grown from a one-plane, eleven-man "corps" commanded by Lieutenant Benjamin Foulois in 1910 to the mightiest air force in the world, capable of flying anywhere on the globe.

Compared to those first Voisins armed with double-barreled shotguns in 1914, the U.S. Air Force's fastest fighter-bomber, the F 4C Phantom II, can load eight tons of armament, including 20-millimeter cannon, rockets, rocket launchers, napalm fire-bombs, 750-pound bombs, Bullpup rockets, and Sidewinder rockets that home in on any heat-radiating target. Modern fighters can deliver their punch at better than 500 miles an hour, and there are already new ones capable of 2,000 miles per hour. Technical progress in the area of defense against aircraft kept pace. Pilots relied on a crew of gunners manning sophisticated firearms, while from the ground rapid-firing anti-aircraft guns like the Bofors blasted the enemy from the sky.

In World War I the weapons of the opposing forces were almost equal but the ability of the allied navies to maintain control of the sea and deny the Germans vital

military supplies tipped the scales in favor of the allies and finally forced the German surrender.

Twenty years later, as World War II began, the strategy and tactics of the opponents were quite different. France bet her chips on the Maginot Line along the French-German border, a complex system of mine fields, steel and cement gun turrets, tunnels, barracks, magazines, and storerooms sunk deep underground and served by elevators, railroads, air-conditioning plants, water lines, and telephone exchanges. The French General Staff, hoping to avoid the slaughter of World War I, found themselves stalemated in a static warfare for which their enemy had an answer.

The Germans made an end run through Belgium around the Maginot line. Their blitzkrieg consisted of hard-hitting, lightning-like, highly mobile panzer attacks on land and Luftwaffe attacks by air in which they bombed and strafed cities and communications. A new and swift battle tank armed with the biggest gun ever carried on a tank served as a mechanized cavalry, and their expanded submarine fleet sank allied shipping faster than it could be replaced.

The Japanese meanwhile were quietly building a powerful navy, expanding a first-class air force, and, in violation of international treaties, fortifying all the Pacific islands they controlled.

The Germans had marched into Poland in September of 1939, and after six months of the "phony war," had attacked and won surrenders from Norway, Denmark, Holland, and Belgium. Then, bypassing the Maginot Line in the north, they overran northern France, took Paris, and Der Fuehrer announced his "Thousand Year" Reich. Mus-

solini joined Hitler in the attack, and the Germans, stopped by the English Channel and the defense measures of Winston Churchill, turned their blitzkrieg tactics east and invaded the Soviet Union. On December 7, 1941, the Japanese attacked Pearl Harbor and World War II became the first global war.

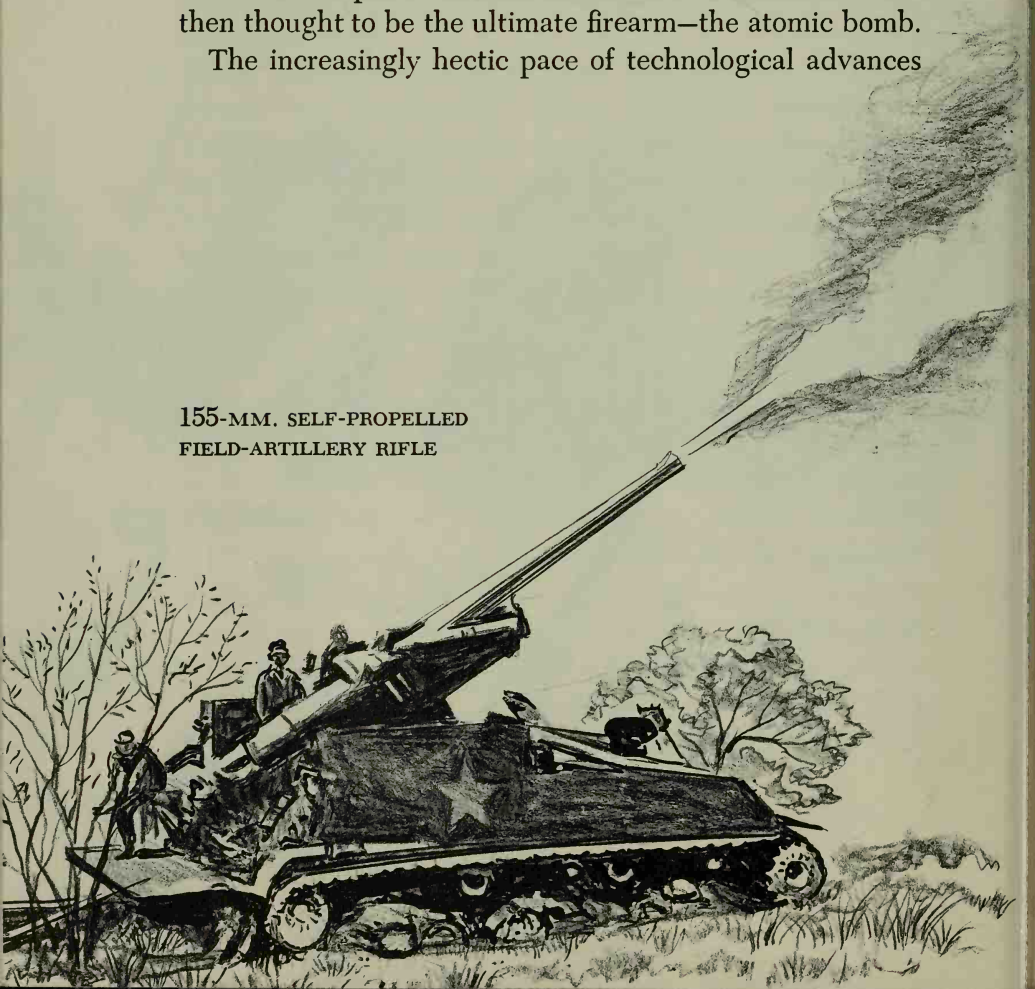
Four years after it began the high tide of axis success began to recede. Allied production of war materials had been expanded and began to pay off. Massive allied bombing raids with heavily armed planes reduced enemy cities

BOFORS QUICK-FIRING ANTIAIRCRAFT GUNS

to rubble, crippling their production and transportation. American and British tanks came off the production lines so fast that they finally outnumbered the German panzers.

The Germans were pushed out of North Africa; increased production of United States shipping and the development of new defense devices overcame the submarine menace. Japan's forward momentum was stopped, Mussolini's fascist government fell, and the allies invaded the continent. Finally Berlin was captured and burned, the megalomaniac in the Reich bunker committed suicide, and the allies turned their full force on Japan, delivering the knockout punch in 1945 with the first use of what was then thought to be the ultimate firearm—the atomic bomb.

The increasingly hectic pace of technological advances



155-MM. SELF-PROPELLED FIELD-ARTILLERY RIFLE

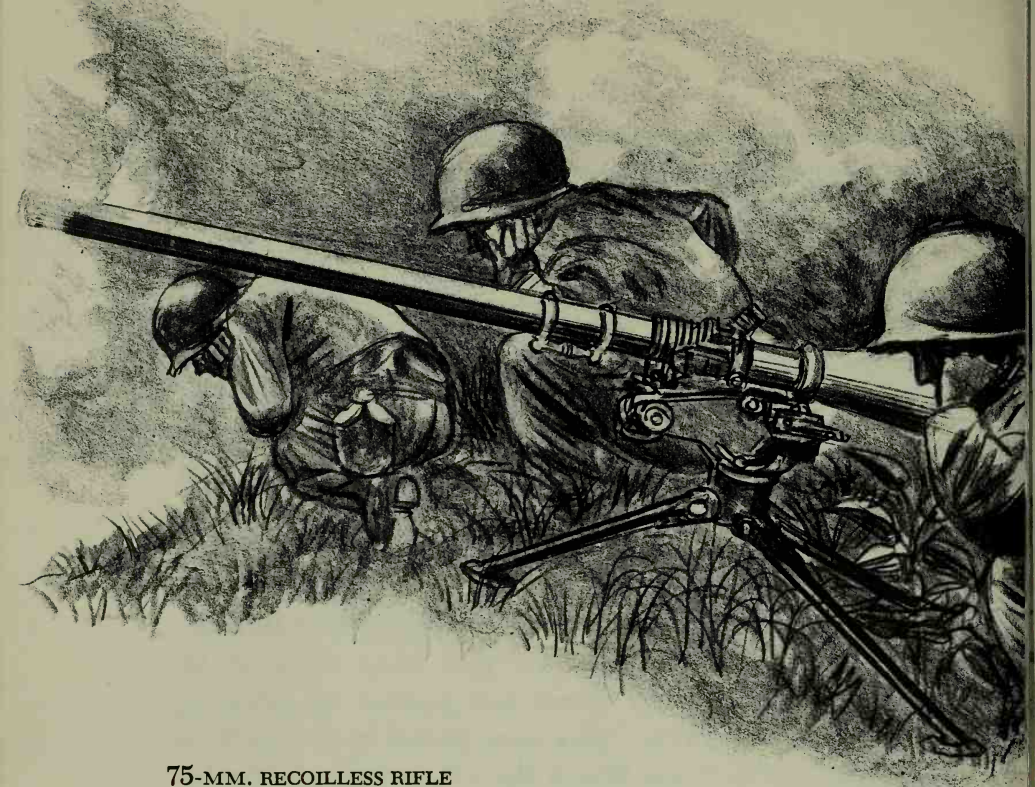
later resulted in an ultimate weapon—the hydrogen bomb —so frightful that no power has yet dared use it in war for fear of instant retaliation.

The Korean War introduced still another battle machine that has flowered more fully in Vietnam—the helicopter. The giant 'copters now drop entire battalions of infantry behind enemy lines; deliver supplies, ammunition, field guns, bazookas, and recoilless rifles to surrounded detachments; evacuate the wounded; spray enemy troops with heavy machine guns; and drop bombs and napalm, the modern equivalent of Greek Fire, on his positions. The helicopters have changed the entire concept of battlefield transportation and tactics.

Over the years there has been constant effort to make fieldpieces more mobile. First they were mounted on wheeled carriages and drawn into position by galloping horses. In World War I they were hauled by clumsy farm tractors, and in World War II the self-propelled field-artillery rifle was mounted on a tank or tractor chassis with caterpillar treads so that the gun's position could be shifted as needed.

Several weapons that are now carried forward in planes and helicopters have added tremendously to the mobility of artillery. The smallest of these is the so-called bazooka, a rocket-launching tube invented during World War II that gives the infantryman an arm with which he can put a tank out of action. It is a metal tube open at both ends that is aimed while resting on the shoulder. A helper slips a small rocket into the rear end of the bazooka and the aimer fires it by a trigger. This weapon revolutionized antitank warfare.

Another advance was the recoilless rifle, which comes in

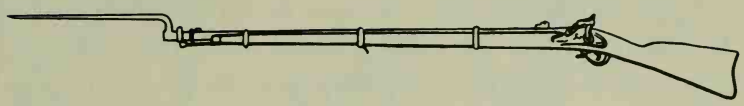


75-MM. RECOILLESS RIFLE

several calibers, has a rifled barrel, and fires a projectile that can be aimed accurately. It is much lighter than a fieldpiece and needs no carriage because the breech gases are expelled from the rear end and there is no recoil.

The helicopter and the airplane are both now armed with up-to-date versions of those pregunpowder weapons, the rockets. Rockets have become more and more sophisticated, with the development of air-to-air, ground-to-air, and ship- or submarine-to-air missiles, whose heat-seeking and radar sensors zero in on enemy war machines.

11 Firearms Oddities



Inventors, in the popular mind, have long been thought of as absent-minded dreamers who concoct offbeat devices that are often miracles of ingenuity. Apparently the membership of the Master Gunsmiths' Guilds has always contained a few such Rube Goldbergs, or perhaps they were just gunsmiths who had time on their hands between wars and enjoyed practicing their art for the fun of it.

Some of them have devised some very odd weapons indeed. So many different variations of every kind of weapon, from the days of the first matchlock to the modern machine gun, have not only been designed but actually built that it would take a much longer book than this merely to list them. There is space only to cover the highlights, but we cannot resist the urge to describe a few of the firearm oddities.

They fall into several classes: *Combination Weapons,* in which two or more weapons are combined into one piece; *Multishot Hand Guns; Disguised Guns,* which are made to look like something else; *Miniature Guns* for lovers of the diminutive; and *Special-Purpose Firearms.*

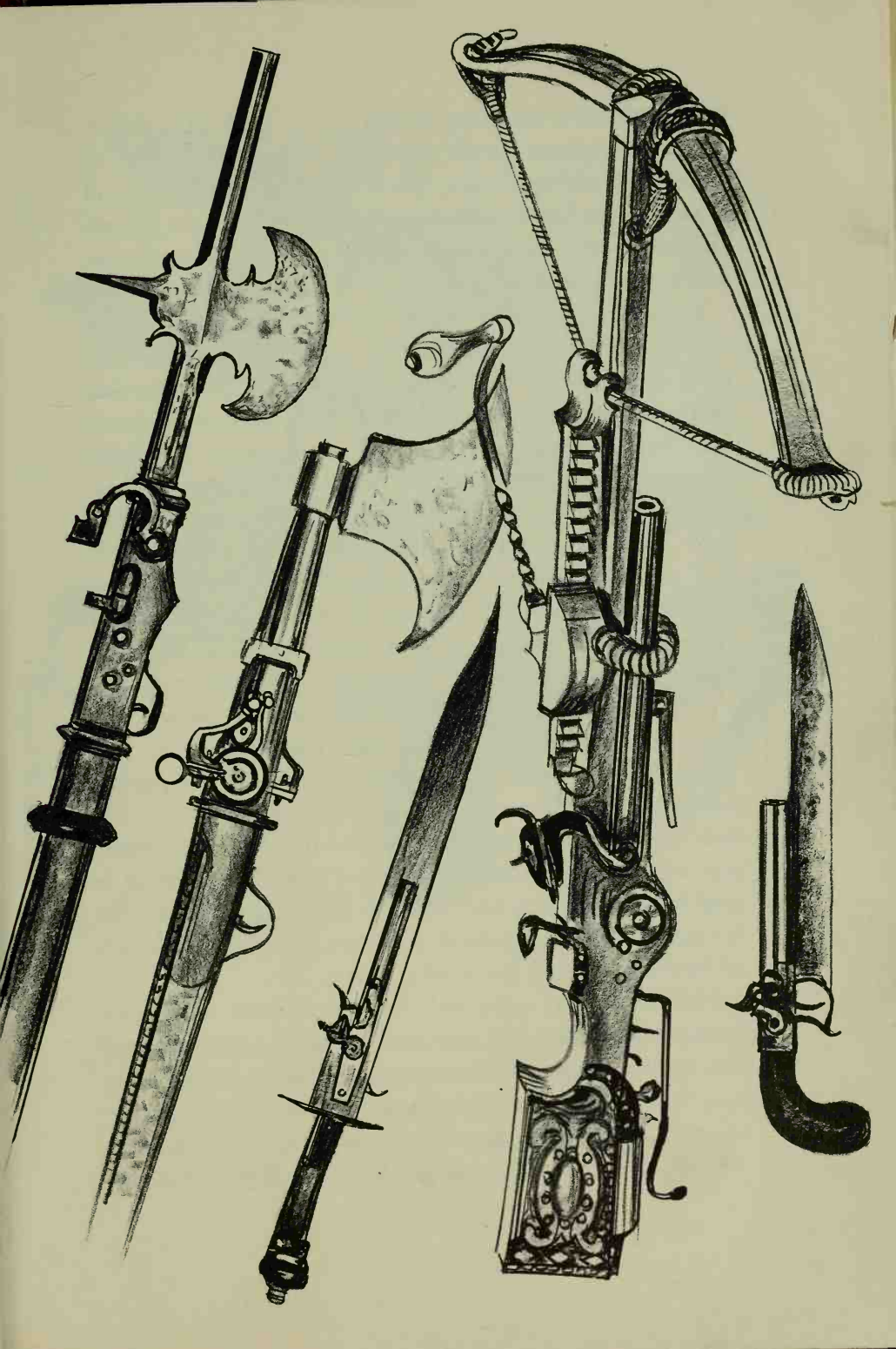
Perhaps the earliest combination weapon was the hand cannon made in the form of a club or mace. They were,

at first, simple tubes loaded with powder and ball and ignited through a touchhole by slow match. But they were designed also to be used as clubs, and some had the lethal spiked projections of a mace at the heavier end. Other multibarreled combinations were known as "holy water sprinklers," perhaps because to sprinkle holy water was a slang phrase for spilling blood. One was listed in a 1547 Tower of London inventory as a "Holly water sprincles wt thre gonnes in the Topp." Later, maces were combined with matchlock, wheel-lock, flintlock, and percussion guns.

Crossbows were also occasionally combined with early guns such as the arquebus. These were hunting weapons—the crossbow that shot bolts, stones, or lead pellets at small game and the arquebus that fired its ball at larger game.

Another obvious and early combination was that of the gun and battle axe. The armored knight was brought down with its ball, and then he and his armor were taken apart with the axe.

Halberds and polearms (lances) were made with hollow shafts to form the barrel of the gun. Polearm percussion guns have been found that have no triggers but fire on impact. When the bayonetlike spear was pushed in it caused the hammer to fall and fire the gun. The user of that one was taking no chances. Both pistols and revolvers have also been combined with cutlasses, swords, and daggers. In 1864 a patent was issued for a triple-threat weapon consisting of a combination pistol and bayonet that could be attached to any shoulder gun. A complicated arrangement of two triggers was supposed to fire the gun and then the pistol, with the *coup de grâce* being delivered by the bayonet. This unlikely weapon may never



have left the drawing board, and probably didn't.

There has been a wide variety of *knife pistols,* many of which had folding blades. They varied in size from small penknives to large jackknives; one even had two barrels and four blades. Some were simply combination weapons, while others were guns disguised to look like knives.

Knife pistols were among the earliest combination weapons, and were used for hunting or war. They have also been designed for the table! There is a double-barreled flintlock pistol that is also a table knife, and another is a fork. Each has only one lock and one flashpan, but there are two vents, and both barrels fire at the same time. Their owner probably also had a combined pistol and candlestick for bedtime. A beautifully designed, ornamented, and probably unique set consisting of knife, fork, and spoon guns, dated 1715, is in the W. Keith Neal collection.

Innumerable ways have been found to conceal weapons besides the usual sheaths, scabbards, and holsters. Canes and walking sticks have concealed not only swords but guns, both pistols and rifles. So have umbrellas.

Pistols have been made in the form of keys, purses, flashlights, and wrenches; they have been built into the handles of riding whips, disguised as tobacco pipes, pens, pencils, and belt buckles. A recent movie introduced a double-barreled brassiere! French and Belgian gunsmiths have even built pepperbox revolvers into the handlebars of bicycles (James Bond take note).

Multishot hand guns include such oddities as double-barreled revolvers. A Frenchman named LeMat designed and built a number of these weapons in the 1860's. They had two triggers and two hammers and were not six-shooters, but ten-shooters, firing nine .40 caliber slugs from the upper barrel and a load of buckshot from the lower.

KNIFE AND FORK PISTOLS

TRIPLE-THREAT FRENCH WEAPON: PISTOL, KNIFE, AND BRASS KNUCKLES

PISTOL-POCKETKNIFE

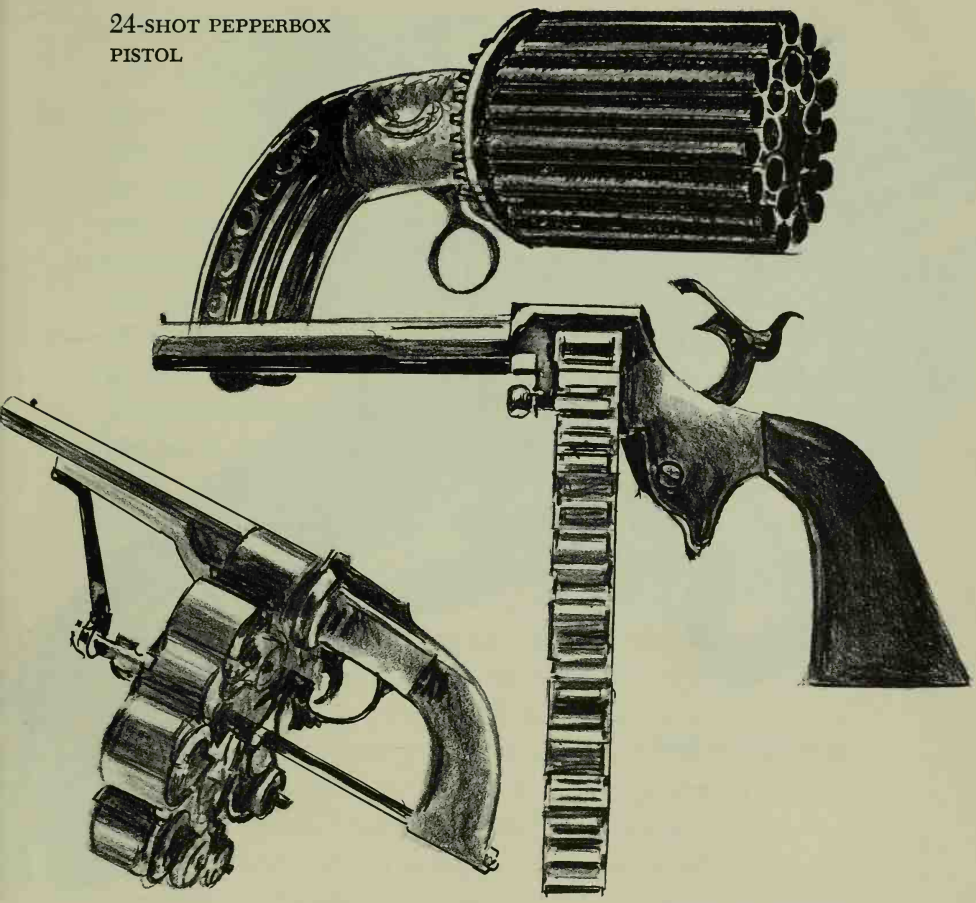
Other two-barrel revolvers had two concentric rows of chambers in their cylinders and fired as many as eighteen or twenty shots. At least two cockeyed inventors made two-barrel revolvers designed to shoot cartridges of two different calibers from the same gun!

A curious multibarrel pistol was the duck-foot flintlock, so called because its four barrels splayed out like ridges in a duck's foot. All four fired together from one flashpan. It was a favorite with sea captains, prison guards, and riot police; members of any mob facing the eight muzzles of a pair of duck's foot pistols must have felt thoroughly covered.

One revolver had a machine-gun action. Instead of a cylinder it had a free-swinging endless belt that carried its cartridges past the breech. One American make held twenty shots, others as many as twenty-five and thirty-two, and rifles using this principle can fire as many as a hundred shots.

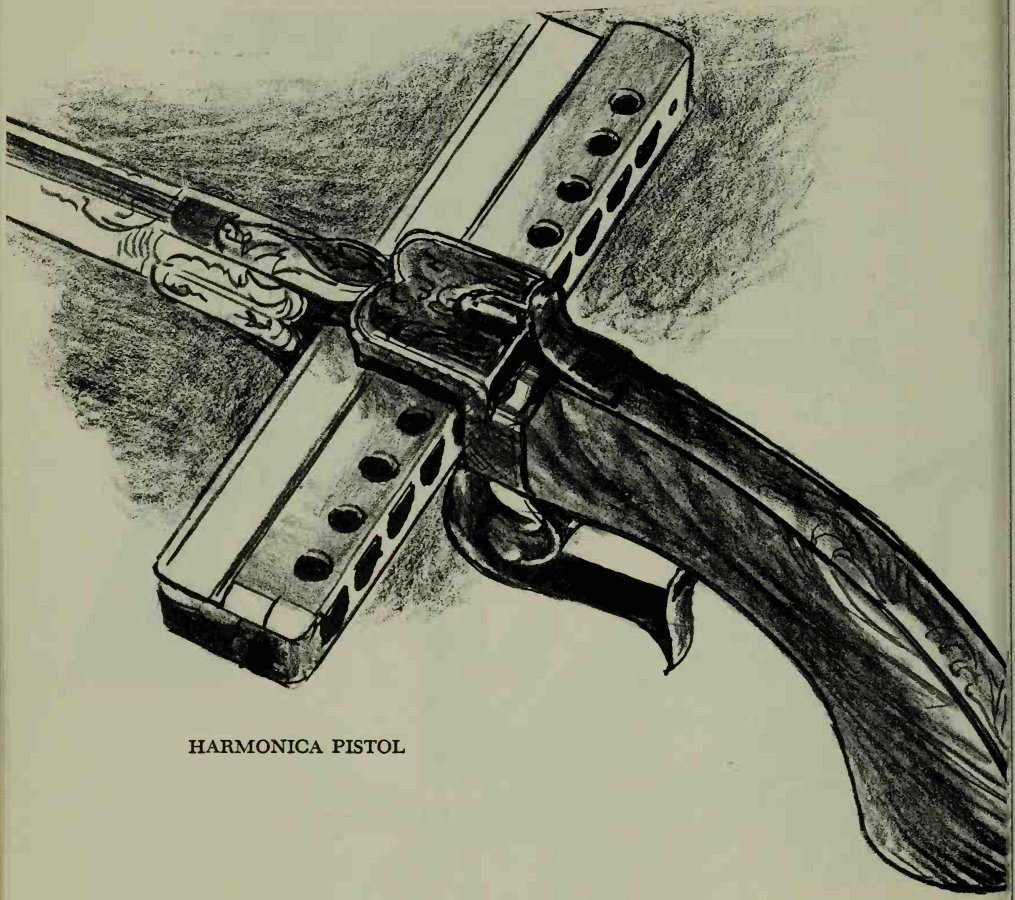
DUCK-FOOT PISTOL

24-SHOT PEPPERBOX PISTOL



TWO MULTISHOT REVOLVERS

Perhaps the world's most complicated revolver was the forty-two shot "Ferris wheel" pistol in which a "compound magazine" revolved around an axle below the gun barrel. The wheel had seven spokes with a six-chambered cylinder at the end of each. As each spoke lined up with the barrel its cylinder locked in place until its six shots had been fired, and then the wheel revolved again—seven six-



HARMONICA PISTOL

shot revolvers in one! It was patented in England by Joseph Enouy in 1855.

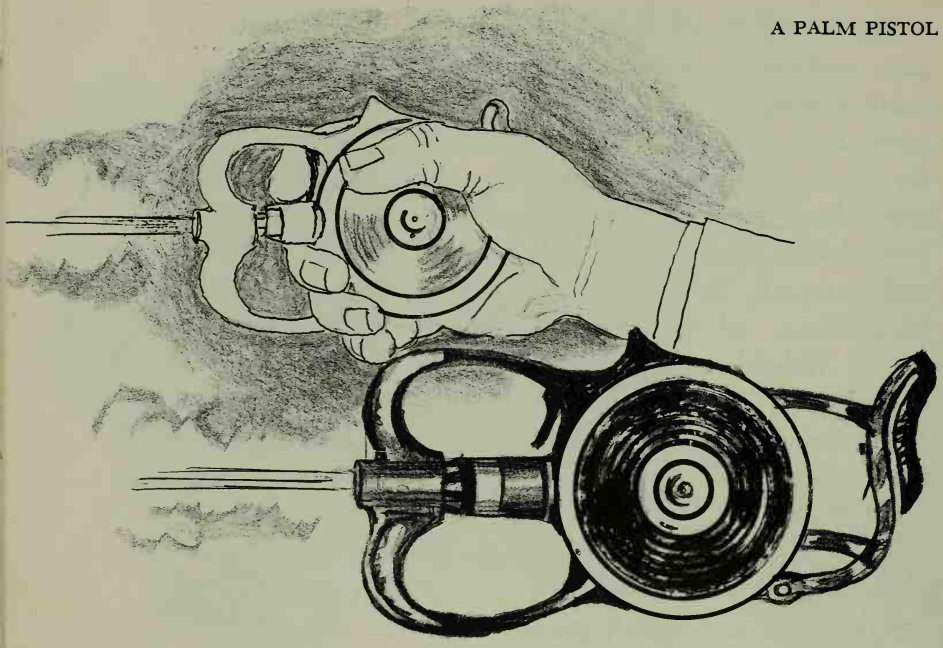
The harmonica pistol is not a musical instrument combined with a gun, but a gun whose cylinder is harmonica-shaped instead of cylindrical. Each time the trigger is pulled, another cartridge (as many as ten in some models) slides in front of the hammer, in some horizontally, in others vertically.

The Lord's Prayer has been engraved on the heads of pins, and secret messages in microdots have been made so small that a microscope is needed to reveal them. Guns haven't shrunk to that size yet, but there are some very tiny ones. New York's Metropolitan Museum of Art's firearm collection contains examples of two- to four-inch–long complicated wheel locks made in the sixteenth century, and an equally tiny Spanish miquelet pistol and miquelet blunderbuss, all in working order. A Leeds gunsmith, G. M. Sibbald, working from the 1880's to the 1930's, probably holds the record for producing the smallest guns. He made working models of engines, carriages, bicycles, locks, and guns whose parts were nearly microscopic. Sibbald, who exhibited his miniatures for fifty years as "The Smallest Show on Earth," made five tiny guns: a one-inch gold revolver, two gold pistols with ivory grips weighing six and a half grams each and encased in a plum stone; two gold pistols, one of which weighs fifteen grams, has thirty-six pieces, and is double-barreled!

A radically different type of weapon is called a *squeezer* or *palm pistol.* It is the shape of a pocket watch and is held inside the fist with the barrel projecting between the fingers. A few were so small that they were almost invisible. The best-known one was advertised in 1892 as the "Protector Revolver" and it carried seven .32 caliber cartridges in its revolving turretlike chamber. The advertisement stressed the fact that it had a safety catch which made it impossible to discharge the weapon accidentally—an important feature when it was carried in a vest pocket. The squeezing action not only revolved the cylinder but also drove a firing pin against the primer.

A first cousin to the squeezer is the knuckle-duster, which is gun and knuckle-duster combined—a handy

A PALM PISTOL

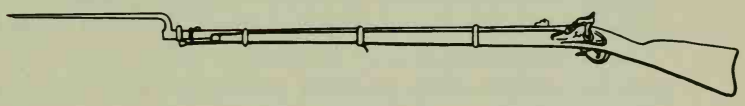


weapon for a roughhouse fight. One model is a pepperbox called "My Friend," patented in 1865; another was advertised as the "Little All Right."

The Apache Knuckle-duster is a French weapon that combines gun, dagger or knife, and brass knuckle and is supposed to have been popular in the Parisian underworld.

If you have an idea for a novel firearm the chances are that it has already been made and may even be long obsolete. The most recent attempt along these lines is that Hollywood invention, the machine-gun-firing automobile.

Glossary



Armada, Spanish: Fleet launched in 1588 by Philip II of Spain against England.

arquebus: *See* harquebus.

Bacon, Roger: Thirteenth-century English monk who wrote first account of gunpowder.

ballistae: Precannon siege machines that hurled huge missiles by counterweighted arms.

ballistite: A kind of smokeless powder.

bar shot: Two cannonballs joined by an iron bar used in naval warfare to damage enemy rigging.

batarde: Early 24-pounder cannon.

bazooka: Shoulder-carried antitank mortar.

blunderbuss: Short, large-bore bell-mouthed musket.

Bofors: Light rapid-fire antiaircraft gun.

bolt: Shaft fired from a crossbow or catapult.

bombard: Late medieval cannon that hurled stone missiles.

bore: Interior tube of a gun.

brig: Two-masted square-rigged vessel.

breech: The part of a cannon or firearm at the rear of the bore.

breechblock: Plug used to close the rear of the bore against the force of the charge.

breeching: Block (and tackle) fastened to the gun carriage to control recoil and secure the carriage.

breechloader: Breech-loading firearm.

Brown Bess: Flintlock smoothbore musket with bronzed barrel formerly used by British army.

Buffalo Bill: William F. Cody, nineteenth-century American plainsman, scout, and showman.

buffalo gun: A model of the Sharps rifle used in hunting buffalo.

caliver: Light, shoulder-fired matchlock gun.

canister: Hollow cylindrical shell filled with musketballs and scrap iron that exploded by a charge inside and scattered its contents.

caravel: Fifteenth-century three- or four-masted broad-bowed lateen-rigged sailing vessel.

carrack: Fifteenth-century three-masted sailing vessel.

carronade: Lightweight short-range cannon that fired a low velocity large-caliber ball.

cartridge: Paper, cloth, or metal container holding powder charge for a firearm.

center-fire: Cartridge fired by the striking of a hammer of a firing pin against a cap or primer at the center of the base.

pin-fire: Cartridge fired by striking of a hammer against a firing pin protruding from the top of gun barrel that is then driven down to explode the cap.

rim-fire: Cartridge having a circle of explosive material all around rim that when struck by a hammer explodes the cap.

cascabel: Knob behind the breech of a muzzle-loading cannon.

catapult: Siege weapon operated like a giant slingshot.

chain shot: Two cannonballs joined by a short chain that were fired at enemy ships to sever their rigging.

Chassepot rifle: French rifle that fired paper cartridge by means of a percussion cap and firing pin; used during the Franco-Prussian War and named after Antoine A. Chassepot.

cog: Broadly built early northern European trading vessel.

Colt "Peacemaker": American-made .45 caliber Colt revolver of 1872 famous on the western frontier; named after Samuel Colt.

columbiad: Cannon invented by Major Bomford of U.S. Army with heavily reinforced breech.

cordite: A kind of smokeless powder.

corning: Process by which grains of caked serpentine powder were sorted by being sifted through various-sized screens.

corned powder: Kerneled powder obtained by corning.

corsier: Early 36-pounder cannon.

Crécy: Site of Edward III's defeat of Philip VI of France in 1346 in a major battle of the Hundred Years War in which the use of the longbow was of decisive importance.

crossbow: Bow mounted crosswise near the end of a wooden stock like a musket's.

culverin: Sixteenth-century 18-pounder cannon.

curtal: Early short-barreled 60-pounder cannon.

derringer: A type of small single-shot pistol popular in the mid-nineteenth century, patterned after the original by Henry Deringer, Jr.

double-action: A firearm capable of being cocked and fired by a single pull of the trigger.

Dreadnaught: British battleship finished in 1907 armed with heavy guns of a single caliber mounted in revolving turrets.

duck-foot pistol: Unusual firearm with four barrels that fanned out like ribs of a fan from breeches and fired from a single flashpan.

Ferguson rifle: Eighteenth-century breech-loading gun in which the breech was opened by unscrewing a breech plug by a trigger-guard lever; named after Patrick Ferguson, a Scot.

Ferris wheel pistol: Pistol with compound magazine that revolved around an axle below the gun barrel. The wheel had seven spokes with a six-chambered cylinder at the end of each. It was patented in England in 1855 by Joseph Enouy.

firelock: Gun employing a slow match to ignite the powder charge.

firemaster: Mounted man who carried a torch to light gunners' matches in early artillery batteries.

firing pin: The pin that strikes the primer of the cartridge in the breech mechanism of a firearm.

first-rater: Line-of-battle ship carrying a hundred or more guns.

flashpan: A pan for priming in a flintlock.

flintlock: (1) Lock with flint fixed in the hammer that struck the battery, ignited powder in the pan, which carried flame through the touchhole to set off the charge.
(2) A firearm with such a lock.

forecastle: A raised deck located in the bow of old warships above the main deck.

Forsyth, Alexander: Scottish minister and inventor who developed percussion ignition for guns and pistols in the early nineteenth century.

frigate: Naval sailing cruiser used for scouting, usually rating from thirty-two to thirty-eight guns.

frizzen: The steel plate against which the flint is struck to set off priming.

galleass: A large, fast galley armed with cannon in use during the sixteenth and seventeenth centuries.

galley: Early one-deck ship propelled by sails and oars.

Gatling gun: American crank-revolved ten-barrel machine gun fed from a hopper. Each barrel fired once during a revolution of the group, giving the gun a capability of six hundred shots a minute; named after Richard J. Gatling.

Gore, Sir George: Wealthy British amateur sportsman who led a buffalo-hunting expedition through the West from 1854 to 1857.

grapeshot: Cluster of small metal balls in container fired from cannon that burst in the air and spread among the enemy.

grapeshot revolver: Gun with smoothbore .60 caliber barrel that fired buckshot located underneath conventional barrel.

Greek fire: Incendiary mixture that burned fiercely when exposed to air or water; used in battle by the Byzantines and others before gunpowder was discovered.

guncotton: Cellulose steeped in nitric acid and dried, which makes a powerful explosive.

gunner's pick: A kind of awl used to prick open a paper cartridge through a cannon's vent in order to explode the charge.

gunner's quadrant: Instrument used to ascertain the elevation of a gun barrel.

Gustavus Adolphus: Seventeenth-century king of Sweden noted for revolutionary artillery tactics in the Thirty Years War.

harmonica pistol: Gun with a ten-chambered magazine that resembled a mouth organ.

harquebus: A portable but heavy matchlock gun invented in the mid-fifteenth century; it was fired with the barrel resting on a forked support.

Henry rifle: Sixteen-shot repeater that fired brass cartridges used in the Civil War; named after its inventor, Benjamin Tyler Henry.

hot shot: Cannonballs heated in a furnace before firing to start fires in enemy buildings.

Hunt, Walter: Prolific nineteenth-century inventor of the volitional repeater, the straight-drive firing pin, and other firearm accessories.

Kalthoff repeater: An ingenious German wheel-lock musket dating from 1640 that could fire from six to thirty shots without reloading.

Kentucky rifle: A long-barreled smallbore rifle that originated in

Pennsylvania. It was extremely accurate and was used by frontiersmen during the eighteenth century.

knifeblade shot: Missiles with blades that flew open on discharge; used to cut the rigging of enemy ships.

langrage: Various iron projectiles joined or encased in a canister; used to damage the rigging of enemy ships.

lanyard: Cord used to pull trigger to fire gun or cannon.

Lewis and Clark: Meriwether Lewis and William Clark, leaders of a military expedition from 1803 to 1806 to explore the territory from the Mississippi through Oregon to the Pacific.

linstock: Forked pole to which slow match was clipped. It was held by a gunner to fire priming of cannon.

long bow: Six-foot bow usually of yew used mainly by English archers.

magazine: Compartment holding cartridges, shells or bullets.

mangonel: A type of catapult.

match: Twisted cord soaked in saltpeter that smoldered slowly but could be blown into flames; used to explode priming charge of matchlock.

matchlock: (1) Slow-burning cord held in an S-shaped arm over the breech and capable of being lowered to ignite the charge. (2) A gun equipped with this device.

Mauser rifle: Bolt-action single-shot rifle of the 1860's, the model for all succeeding guns of its type; named after its inventor, Peter Mauser.

Maxim machine gun: First successful machine gun; named after its inventor, Hiram Maxim.

Milemete, Walter de: Chaplain of Edward III of England and author of an illustrated manuscript (1326) in which the earliest picture of a cannon appears.

mine: An encased explosive placed in the water, on or under the earth that may be detonated by contact or controlled means; designed to destroy enemy vehicles or personnel.

Minié ball or minny ball: Lead rifle bullet with hollowed-out cylindrical body containing iron plug that expanded to grip the rifling of a gun barrel when the weapon was fired.

miquelet: Spanish gunlock that preceded and resembled the flintlock and was distinguished by an external mounting of mainspring and hammer.

mortar: Muzzle-loading cannon with a tube that was short in rela-

tion to its caliber and that was used to hurl projectiles such as rockets and grenades at high angles.

moyenne: Early 18-pounder cannon.

musket: Heavy large-caliber shoulder-fired gun.

muzzle-loader: A firearm that receives the cartridge or projectile at the muzzle.

needle gun: The first firearm in which a sharp steel needle was driven by a hammer into a cartridge, striking and detonating a percussion cap inside it.

organ gun: Multifiring gun with a row of barrels mounted side by side on a block resembling the pipes of an organ.

padroes: Stone pillars carved with Portuguese royal arms that marked Portugal's colonial territory.

Paixhan cannon: French gun that fires an explosive shell; named after a French artillery officer.

palm pistol: Pistol that can be enclosed in the palm of the hand, sometimes so that it is not visible; also called a squeeze gun.

parrot rifle: Cannon used extensively during Civil War, with heavily built up breech which sometimes burst near the weaker muzzle.

patch: Greased or moistened piece of leather that was wrapped around the bullet to make it fit snugly in gun barrel.

Pauly, Johannes Samuel: Swiss inventor of the gas-tight brass cartridge.

pepperbox pistol: Pistol with a cluster of five or six full-length barrels, one for each bullet, which revolved on a central axis and were fired individually, in the manner of a revolver cylinder.

percussion cap: Small copper cap filled with fulminate of mercury that was set on top of the nipple of the gun. It exploded when the hammer of the gun struck it, setting off the charge.

percussion lock: Lock of firearm fired by percussion.

petronel: Large-caliber gun fired with butt against the chest.

powder horn: Container that held gunner's supply of powder, usually made from a cow's horn.

priming pan: Shallow pan alongside touchhole of a muzzle-loader into which priming powder was poured to set off charge.

priming powder: Very fine-grained powder used to prime gun.

Puckle, James: Inventor of an early machine gun (1718) capable of firing eight shots a minute; the Puckle gun was equipped with a magazine that fired square bullets.

quoins: Wedges placed under the breech of cannon to adjust the elevation of the muzzle.

Remington rifle: A breech-loading rifle, named after Eliphalet Remington, early nineteenth-century inventor and gunsmith.

repeater: Gun capable of firing more than one shot without being reloaded.

revolver: Hand gun with revolving cylinder containing bullets.

rifle: Shoulder-fired gun with spiral grooves cut into inside of barrel to give bullet a spin or twist for greater accuracy.

rifling: Grooves inside of a gun barrel that are cut in a spiral to make bullet spin about its longer axis.

ribaudequin: A medieval engine of war, consisting of a protected elevated staging on wheels, armed in front with pikes and after the fourteenth century with small cannon.

Roman candle gun: Gun in which a number of charges were loaded, one behind the other, into the barrel, each setting off the one behind it as it exploded.

sear: Catch holding the hammer of a gun lock at cock or half cock.

serpentine: Curved arm shaped like a striking snake that held the burning match on a matchlock gun.

serpentine powder: Fine dustlike gunpowder used in early guns.

Sharps rifle: A breech-loading rifle patented in 1848 by Christian Sharps that was widely used during the Civil War.

shotting: Process for making shot by dripping molten lead in thin streams from a height through sieves. Spheres formed as the lead fell into a water tank below.

shot tower: Tower that provided height for shotting.

single-action: Describes firearm that requires manual reloading before each shot.

slow-match: *See* match.

Smith & Wesson: Well-known revolver made by Smith & Wesson, which is hinged to break open for loading.

smoothbore: Refers to gun with a barrel that is not rifled.

snaphance: A gun fired by flint in cock that strikes against a steel battery, sending sparks into the priming pan. The term was derived from the Dutch *snaphaan* or snapping cock.

Spencer rifle: A seven-shot lever-action repeater used during the Civil War; named after Christopher Spencer.

sterncastle or aftercastle: A raised deck located above the stern of old sailing warships.

tampion: Wooden plug fitted into the muzzle of a gun to keep moisture out of the barrel.

Thompson submarine gun: Known as the tommy gun. A light porta-

ble automatic weapon fed from a magazine or drum and provided with a pistol grip and a buttstock for firing from the shoulder. Named after John T. Thompson, an American army officer.

touchhole: *See* vent.

trade gun: Musket made especially to sell to American Indians.

trapdoor Springfield: Civil War muzzleloader that could be converted to a breechloader by a hinged breechblock.

trunnion: An axle added to both sides of a cannon at its center of balance that enables it to be elevated.

tumble-home: Receding upward curve of ship's side from waterline to rail.

vent: Small hole in the breech of a firearm through which flame from the priming pan reaches the gun's charge.

volitional repeater: A repeater that stores cartridges in a magazine tube in the gun butt; built by Walter Hunt in 1849.

wadding: Paper or cloth stuffed into gunbore to hold charge in place.

wheel lock: (1) Lock in which sparks are struck from a flint or a piece of iron pyrites by a revolving wheel with serrated edges. (2) Gun equipped with such a lock.

Winchester '73: Favorite weapon of plainsmen and Indians in the 1870's in the West; named for its manufacturer, Oliver F. Winchester.

windage: Space between the projectile of a smoothbore gun and the surface of the bore.

worm: Corkscrewlike tool used to remove unburned material remaining in the breech after the charge has exploded.

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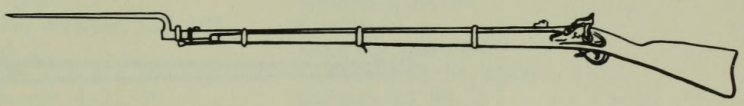

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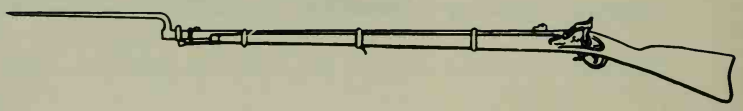

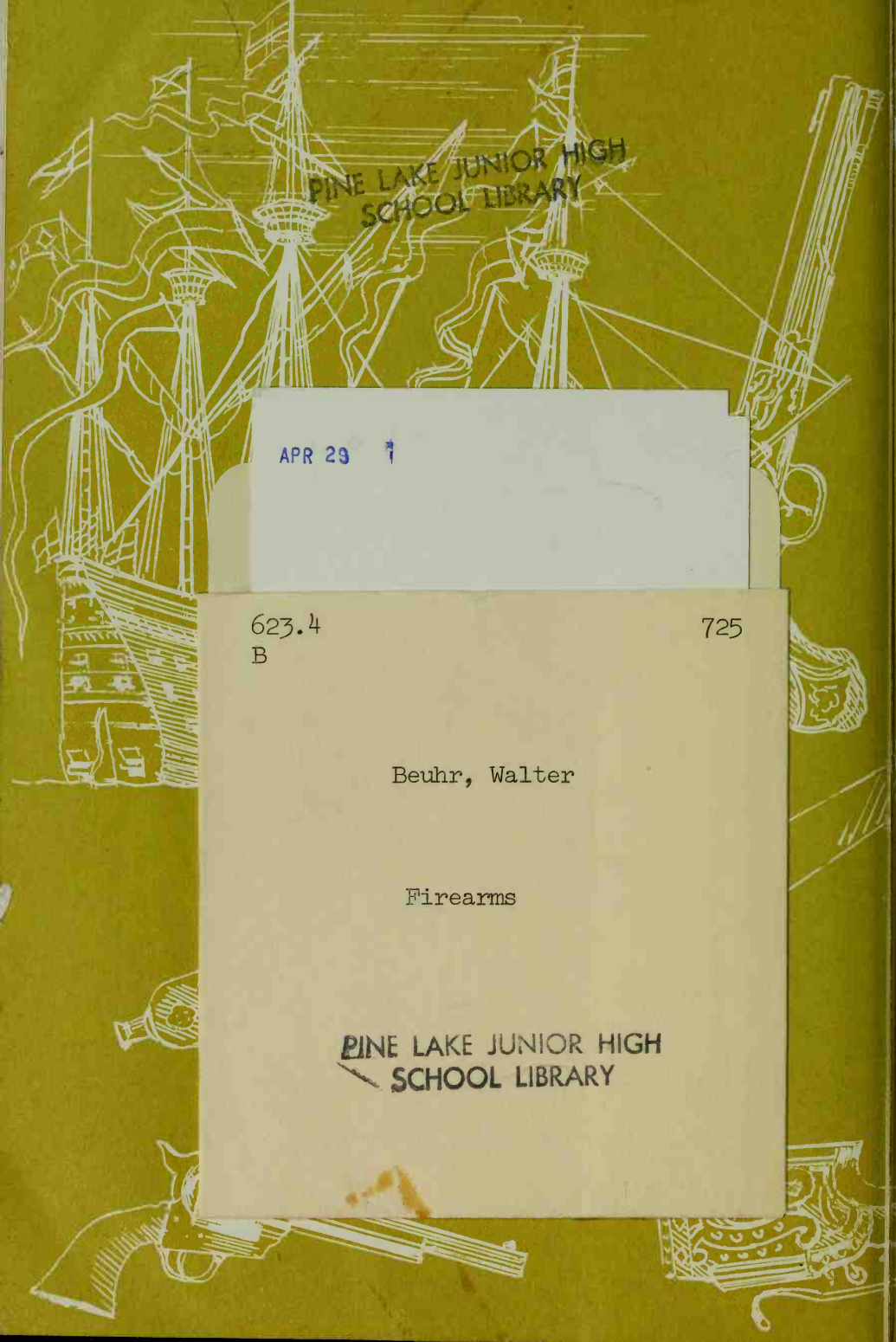

Beuhr, Walter

Firearms

(continued from front flap)

vented in 1860, which led to the discharge of a Union general by President Lincoln himself.

Among the unusual firearms in Mr. Buehr's collection are the "duckfoot" pistol; a place setting of armed silverware—knife and fork combined with pistols; and the nearly invisible, multibarreled "squeezer," or palm pistol, no bigger than a pocket watch.

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WALTER BUEHR attended the Detroit School of Design, the Philadelphia School of Industrial Art, and the Art Students League in New York. He has written and illustrated many books on medieval life and military tactics, as well as magazine articles on architecture and boating, about which he is an enthusiast. He cruised the Mediterranean to gather information on Spanish and Moorish weapons, forts, and ships. Mr. Buehr lives in Noroton, Connecticut, with his wife, Camilla Buehr, a portrait painter.

Mr. Buehr's *Warriors' Weapons* was named a "Reference Book of 1963" by the American Library Association.

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